

Technical Report 497

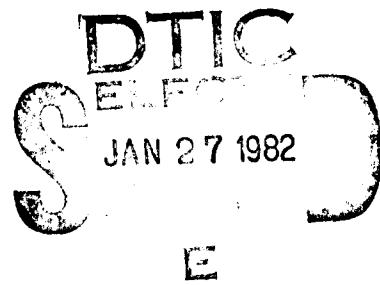
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**USER-ELICITED TACTICAL INFORMATION  
REQUIREMENTS WITH IMPLICATIONS FOR  
SYMOLOGY AND GRAPHIC  
PORTRAYAL STANDARDS**

AD A110161

Betty M. Landee and Michael G. Samet  
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April 1980

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In addition, for each question, the participants completed a form which provided descriptive information such as whether the answer to the question is available from a display with conventional symbology (FM 21-30). In an effort to organize the information requirements, an hierarchical clustering technique was applied that analyzed the similarity between questions in terms of 58 semantic features (e.g., friendly, enemy, artillery, vulnerability, etc.).

The elicitation sessions resulted in the generation of a total of 272 distinct tactical questions. These questions formed seven major clusters which were assigned the following names to reflect the central theme of their respective information content: friendly, enemy, time/capability, status, activities/procedures, terrain/routes, and planning. The descriptive data about the questions, analyzed for each cluster of information individually and for the entire set of questions, indicated that conventional symbology fails in many respects to meet basic user needs. For example, 43% of the information requirements identified were said to be unavailable from a conventional display. Furthermore, there appears to be a proliferation of personalized techniques being employed by users to portray their information requirements. Some major informational deficiencies in conventional symbology are identified, and examples are given on how the findings can be employed in development efforts toward making standardized, tactical symbology more useful and effective.

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# USER-ELICITED TACTICAL INFORMATION REQUIREMENTS WITH IMPLICATIONS FOR SYMOLOGY AND GRAPHIC PORTRAYAL STANDARDS

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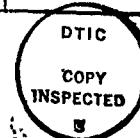
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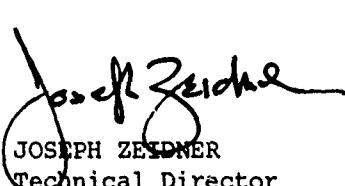
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FOREWORD

The Human Factors Technical Area of the Army Research Institute for the Behavioral and Social Sciences (ARI) is concerned with aiding users and operators to cope with the ever increasing complexity of the man-machine systems being designed to acquire, transmit, process, disseminate, and utilize tactical information on the battlefield. The research is focused on the interface problems and interactions within command and control centers and is concerned with such areas as topographic products and procedures, tactical symbology, user-oriented systems, information management, staff operations and procedures, sensor systems integration and utilization, and issues of system development.

The current symbology, as provided in FM 21-30 and FM 21-21, is widely agreed to be inadequate. As a result, a number of Army agencies are working to evolve special subsets of new or modified symbols that are better suited to their particular information-processing needs. In the absence of a common frame of reference, these efforts could result in a proliferation of specialized symbols that meet the needs of some, but not all, potential users. The present publication tries to identify and categorize the situational, information, and behavioral factors that contribute to the effective design and use of visual symbols for representing the battlefield. This analysis is a necessary first step in the development of a comprehensive framework, typology, and theory of tactical symbology.

Research in the area of tactical symbology is conducted as an in-house effort augmented through contracts with organizations selected for their specialized capabilities and unique facilities. The present study was conducted by personnel of Perceptronics, Inc., under Contract DAHC19-78-C-0018. This research is responsive to requirements of Army Project 2Q762722A765 and related to special requirements of the Combined Arms Combat Development Activity, Fort Leavenworth, Kans. Special requirements are contained in Human Resource Need 80-307, Optimizing Display of Topographic and Dynamic Battlefield Information, 81-57 Strategy for Design and Improvement of Communications, and 81-96 Effectiveness of Multicolor Air Defense Weapon Systems Display.

  
JOSEPH ZEDNER  
Technical Director

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We are grateful for the cooperation and courtesy extended to the research team by the U.S. Army War College (Carlisle Barracks, Pa.) and the National War College (Washington, D.C.). We are indebted to the students of these colleges who participated in this research effort; we thank these officers for their patience, valuable insights, and interest in this work. Further, we thank Francois G. Christen for performing the statistical cluster analysis reported here, and Franklin L. Moses and Harold Martinék for their valuable comments on the draft manuscript.

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USER-ELICITED TACTICAL INFORMATION REQUIREMENTS WITH IMPLICATIONS  
FOR SYMBOLIC AND GRAPHIC PORTRAYAL STANDARDS

BRIEF

Requirement:

The primary purpose of this research was to elicit and organize selected battlefield information requirements of command staff personnel, and to examine the adequacy of conventional symbology and graphic procedures now in use for satisfying these requirements.

Procedure:

An elicitation procedure was developed and employed to identify tactical information requirements. The procedure involved small groups of military officers in a tactical role-playing exercise using a specified Division-level scenario (European setting, defensive posture). Information requirements in the form of tactical questions were generated and reviewed by participants, both individually and together. In addition, for each question, the participants provided descriptive information such as whether the answer to the question was obvious, derivable, or unavailable from a display with conventional symbology (FM 21-30). The information requirements were organized into a meaningful structure by using a semantic clustering technique. This technique required the content of each question to be analyzed and described in terms of semantic features. A total of 58 features (e.g., friendly, enemy, configuration, vulnerability, etc.) were derived for this purpose; an index of feature similarity was then calculated across questions and a hierarchical cluster analysis was performed.

Findings:

The elicitation sessions resulted in the generation of a total of 272 different tactical questions. When subjected to the cluster analysis procedure, these questions formed 7 major clusters which were assigned the following names to reflect the central theme of their respective information content: friendly, enemy, time/capability, status, activities/procedures, terrain/routes, and planning. The descriptive information about the questions was analyzed for each cluster individually and for the entire set of questions. Overall, the results indicate that conventional symbology fails in many respects to meet basic information needs of users. For example, 43% of the information requirements identified were said by users to be unavailable from a conventional display. Furthermore, there appears to be a proliferation of personalized techniques being employed by users to portray their information requirements. In general, some major deficiencies in conventional symbology were identified with respect to the portrayal of specific areas of tactical information, such as friendly unit information and dynamic information (including availability and current status).

**Utilization of Findings:**

The findings of this research can be employed in development efforts toward making tactical symbology and graphic displays more responsive to user needs. Such efforts should stress the completeness, refinement, and standardization in the graphic portrayal of battlefield information.

USER-ELICITED TACTICAL INFORMATION REQUIREMENTS WITH  
IMPLICATIONS FOR SYMBOLIC AND GRAPHIC PORTRAYAL  
STANDARDS

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**USER-ELICITED TACTICAL INFORMATION REQUIREMENTS WITH IMPLICATIONS  
FOR SYMBOLIC AND GRAPHIC PORTRAYAL STANDARDS**

**1. INTRODUCTION**

**Overview**

Tactical symbology is an important medium or tool in the planning, analysis, and communication of command functions. In this regard, Sidorsky, Gellman, and Moses (1979) offered the following definition:

Tactical symbology refers to the symbols used to portray the information acquired, manipulated and displayed by a Tactical Operations Center (TOC) in supporting the on-line information needs of a commander engaged in planning and/or conducting a combat operation.

Because of a growing awareness of the deficiencies and limitations of current symbology for meeting the modern command and control requirements that accompany emerging tactical doctrine and advancing technology, research efforts have begun toward the establishment of a framework for the development of improved tactical symbology (Ciccone, Samet, & Channon, 1979).

The focus of the work described in the current report concerns tactical information requirements. A preliminary functional analysis of information requirements was performed based on one set of operational tasks which currently depend on tactical symbology as well as those which might, in the future, be supported by symbology. The overall goal was to identify a broad range of battlefield information requirements which represent typical tasks performed by different military users. In addition, in light of the needs specified, an analysis of the adequacy of conventional symbology for fulfilling them was accomplished. To meet the research objectives, a methodology was developed to elicit specific information requirements from appropriate users, and to organize these requirements into a meaningful structure and to analyze the requirements accordingly.

**Statement of the Problem**

The use of military symbols dates back to the days of Napoleon. Warfare has changed since that era and so have the methods by which the battlefield environment is graphically portrayed. Yet the symbology used to portray the tactical situation has remained the same for decades. Conventional symbology (as represented in U.S. Army Field Manual 21-30, Military Symbols) is frequently an integral part of tactical graphic displays which provide command staffs with an overview of the friendly and enemy battlefield situation. The symbology of FM 21-30, and its related NATO version, provides a communicative language for the U.S. Army and other services as well as the Allied Nations. However, there is a widespread consensus that the mechanics and utility of the current symbol system are being severely strained by the increasing volume and complexity of tactical data.

In particular, conventional symbology has been criticized for such reasons as: the level of detail is often inappropriate; the elements of the code are hard to remember; the extraction of salient information is difficult; and the adaption to automated displays is cumbersome and inefficient. In an effort to compensate for the inadequacies of conventional symbology, users frequently augment or modify basic symbols to fulfill their needs. While personalization of symbols may be a functional approach from the user perspective, the lack of standardization could severely diminish the communicative value of the symbology across different user groups (e.g., echelons, TOC personnel, etc.). Furthermore, if standard symbology does not keep pace with actual user needs, then the employment of personalized portrayal methods is likely to increase. Hence, analytical and empirical work is required to carefully identify current problems with symbology use and to suggest promising, standardized solutions that incorporate both human factors and technological considerations.

Fortunately, modern electronic storage and display systems are now available that may significantly reduce the tactical information processing burden. Whereas conventional symbology is static in nature--requiring a one-to-one mapping of symbol-to-concept, symbolologies used with automated systems may be dynamic--permitting the form and content of symbols to change in response to changing user requirements. Consonant with this increase in information processing and display power, modern symbology may come to assume a larger role in tactical assessment and planning. The issue remains, however, that any innovations in tactical symbology and display systems must be responsive to user needs, and emphasis on standardization will be critical.

Thus, emerging doctrine and advancing technology call for the development of improved tactical symbology. Although conventional symbology (FM 21-30) can convey basic unit information (e.g., identify, function, size, and unit type), it cannot communicate a richness of detail considered important by command personnel, and it cannot accommodate most of the new essential elements of tactical doctrine (e.g., U.S. Army Field Manual 100-5, Operations). An improved tactical symbology needs to aim at portraying dimensions of information such as the dynamic composition of units (e.g., combined-arms team), unit capability (e.g., threat, effectiveness, mobility, firepower, logistics, terrain, support, and density), and the updated nature of elements in a current display (e.g., changes in unit position). Such parameters of information, which vary in their degree of abstractness, appear to be necessary for supporting modern tactical performance.

As a specific example, the issues concerning the graphic portrayal of unit capability can be discussed in terms of related information requirements (Ciccone, et al., 1979). Such requirements can be presented conveniently in the form of tactical questions. For example, the following might be key questions in determining what is important about the capability of an enemy unit:

1. Is it a striking unit?
2. How powerful is it?
3. With what force and range can it strike?

4. Is it moving now?

5. Is it changing its structure (e.g., assembling into a combined arms formation)?

Some experts consider these questions to be so important that they should take precedence over other related information requirements such as static order-of-battle details (e.g., training and tactics). With unit capability serving as only one example among many, symbology development appears to require an expanded tactical data base (i.e., organized set of information requirements) to accommodate both the emerging principles of tactical doctrine and the increased precision and range of modern weaponry.

However, an organized data base of tactical information requirements can be formulated only through the application of an appropriate and valid methodology. The selection of such a methodology presents a challenging methodological problem, resulting from a combination of several factors. For one thing, although they often pinpoint objectives, field manuals on tactical doctrine are very general in nature and rarely provide detailed, useful lists of the information content a user must acquire in order to perform routine intelligence and operations tasks; and such lists do not appear to exist within the circulated or uncirculated military literature. For another thing, the development of systematic easily replicable and objective techniques for defining information requirements has been less than encouraging (see Saalberg, Miller, Friesz, & Keegan, 1977, for a brief review). Various applications of some of the more basic psychological measurement techniques for eliciting military information requirements, such as checklists (e.g., McKendry, Wilson, Mace, & Baker, 1973), ranking and rating procedures (e.g., Coates & McCourt, 1976), and introspective reports and protocol analysis (e.g., Bowen, Halpin, Long, Lukas, Mullarkey, & Triggs, 1973; Wilcox, 1972) have made some gains but, for the most part, they have provided static results without much potential for improving the design of military information processing systems. Given this background, the current project sought a more effective, formal methodology for eliciting candidate information requirements from experienced military tacticians.

### Objectives

Overall, the objective of the current work was to generate a set of representative information requirements for symbology. While symbology development was a prime concern of this research effort, no attempt was made to distinguish between information requirements that could or could not, or should or should not, be portrayed in graphic displays. Rather, the objective was to begin formulating a data base of information requirements that is independent of state-of-the-art display capability constraints. As an additional research goal, a preliminary analysis was undertaken to assess the adequacy of conventional symbology to meet the specified information requirements.

### Technical Approach

To meet these objectives, an approach was formulated based on the assumption that deciding what information to portray in an improved symbology can be derived by deciding what questions it should be able to answer for specific users and different tactical tasks. Specifically, the process of asking questions in the context of a given scenario seems to represent a more straightforward and less ambiguous task than creating or checking lists of information requirements. Perhaps this is because some form of self-interrogation always intervenes, either covertly or overtly, when individuals try to identify their information "requirements." Furthermore, once a question is stated, reflection upon the range of possible "answers" to it can help refine the question's meaning and stimulate the generation of other important questions.

Using the question-and-answer model as its core, an information requirements elicitation procedure was developed for repeated application with different groups of tactical officers. The approach took the form of a role-playing exercise in which participants were instructed to generate tactical questions which, if adequately answered, would permit them to comply with the doctrinal requirements of standard military practice. To help guide the elicitation process, participants worked within a specifically defined tactical scenario and they were prompted so as to address certain basic issues in tactical information processing, such as: "Understand the Enemy," "See the Battlefield," "Concentrate at the Critical Times and Places," etc. So, for example, in response to "Understand the Enemy," one might ask: "What is the principal deficiency of a specific enemy unit (e.g., mobility, personnel, ammunition...)?". In addition, a form was prepared to enable participants to provide descriptive information for each question such as whether the potential answer would be obvious, derivable, or unavailable from a display with conventional symbology. Finally, a semantic cluster-analysis technique was developed so that the hundreds of tactical questions that were generated by the elicitation procedure could be classified/organized into meaningful structures.

### Report Organization

The remainder of this report is organized as follows. Chapter 2 provides a detailed account of the methodology used for information elicitation and organization. Chapter 3 describes the study results in terms of clusters or related tactical questions and an analysis of the capability of conventional symbology to satisfy these requirements. Finally, Chapter 4 gives a discussion of the significance and implications of the results, including examples of how they may be used to support the development of improved tactical symbology. Supplementary material regarding the method and results sections is provided in the appendix.

## 2. METHOD

### General

To meet the research objectives, an integrated methodology was formulated based on an adaptation of an information elicitation procedure developed in a previous phase of this work (Ciccone, Samet, & Channon, 1979). The procedure was extended and refined in order to serve as a systematic, structured method that could be replicated with a number of participant groups. In general, the concerns that guided the development and application of the method included operational practicality and efficiency, task realism and credibility, and the potential for promoting creative responses.

The elicitation procedure combined what appeared to be advantageous features of different methods used in the specification of information requirements; in particular, features were selected that would seem to be familiar to, and work effectively with, Army officers. One such feature was the implementation of a tactical game-simulation framework into the task environment (Olmstead & Elder, 1978). This approach to the analysis of military information has, in fact, been successfully demonstrated for complex tactical simulation environments like the Simulated Tactical Operations System (SIMTOS) (e.g., Levit, Alden, Erickson, & Heaton, 1977) and the Combined Arms Tactical Training Simulator (CATTS) (e.g., Kaplan & Barber, 1979). Another important feature of the method was to have participants work both as individuals and in groups so as to enhance the motivation, knowledge pool, relevance, and productivity of task effort (Hackman & Morris, 1974). Because the generation of original responses was so important, it was thought that participants would become more creative and productive while responding in a game-like, somewhat competitive atmosphere.

### Group Composition

The elicitation procedure utilized four groups consisting of three to four students each from the National War College in Washington, D.C., and the Army War College in Carlisle Barracks, Pa. Each participant was required to play a specific Division Tactical Operating Center (TOC) role, such as G-2 or G-3. The role assigned to each participant was based on his tactical background (e.g., intelligence, operations, etc.) as determined by a brief interview prior to the beginning of a session. Across the four sessions, the following frequencies of occurrence of specific TOC roles were represented, without duplication of roles within a session: Commander, three participants; G-2 (Intelligence), three participants; G-3 (Operations), four participants; G-4 (Logistics), two participants; and Fire Support Coordinator (FSCOORD), two participants. However, it should be noted that some participants had background experience in more than one area, such as both intelligence and operations. These individuals, though assigned a specific role, were permitted to draw upon their diverse background experience rather than be restricted to the information needs of their specified role.

### Elicitation Procedure

Table 1 provides a list of the sequence of events involved in the elicitation of user-based information requirements. To acquaint participants with the goals of the exercise, the session began with a brief presentation of relevant research background material (see Appendix A-1). The procedure was then facilitated by a specific instructional setting, which included a strategic scenario background and "doctrinal prompts." The scenario, which was employed for all elicitation sessions, was abstracted from the U.S. Army Command and General Staff College course entitled "Forward Deployed Force Operations (European Setting)." The scenario (see Appendix A-2) contained the following elements: (1) an account of the events leading up to the present tactical situation; (2) a mission statement; (3) comparison of forces; and (4) task organization. Accompanying the written scenario were two 1:50,000 topographic maps of Germany (USACGSC 50-242 and 50-243) which were provided for the participants' reference. Additionally, a sequence of three situation overlays was attached to the maps at various times throughout the session to display pre-engagement arrangement of forces (friendly and enemy), movement to contact of forces, and engagement of forces, respectively. The doctrinal prompts, stated in terms of tactical fundamentals, were implemented to remind participants of the critical aspects of battle, as specified by defensive doctrine.

To introduce the question generation technique, instructions were read to participants by the experimenter. These instructions began as follows:

Our goal is to translate doctrine into guidelines for the graphic portrayal of battlefield information. To accomplish this goal we need to put together a data base of the information requirements needed in today's TOC. The data base will consist of questions which various TOC personnel must ask in order to do their assigned job. The questions will be related to the fundamentals of doctrine as specified by FM 100-5 and FM 71-100. I will read excerpts from FM 71-100 about each of the fundamentals of defense. As I read these statements I'd like you to think about the application of these principles to graphic portrayal. For example, the first two fundamentals of defense are "Understand the Enemy" and "See the Battlefield"; in the form of question, you will be asked to itemize what you need to know to "Understand the Enemy," and "See the Battlefield."

After I have read the excerpts I will give you a sample of the types of questions and answers which were formulated during the first year of the research effort. Following a review of sample questions and answers, I would like each of you to write out your information requirements to do your job. Please write only one question per card. In addition, please write one possible answer to each question on the same card. This should be an answer, not an explanation of the question. As you are thinking about the type of answer to a given question, you may consider whether knowledge of the potential answer might lead you to ask other questions--if so, feel free to write these questions on additional cards.

TABLE 1  
ELICITATION PROCEDURE: SEQUENCE OF SESSION EVENTS

1. Research background presented.
2. Military scenario presented.
3. Question generation instructions given.
4. Excerpts from fundamentals of defense - (1) "Understand the Enemy" and (2) "See the Battlefield" (corresponding overlay depicting pre-engagement of friendly and enemy units) presented together.
5. Individual questions generated (10-minutes).
6. Questions discussed by group.
7. Question Data Forms (QDFs) completed by each participant for his own questions.
8. Brief break taken.
9. Excerpts from fundamentals of defense - (3) "Concentrate at the Critical Times and Places" (corresponding overlay depicting movement to contact of forces) presented.
10. Steps 5, 6, and 7 repeated.
11. Excerpts from fundamentals of defense - (4) "Fight as a Combined Arms Team" and (5) "Exploit the Advantages of the Defender" (corresponding overall depicted engagement of forces) presented together.
12. Steps 5, 6, and 7 repeated.
13. Participants debriefed.

A total of five fundamentals of defense were employed as doctrinal prompts and these were presented in three separate sets (see Appendix A-3): fundamentals (1) and (2) together; fundamental (3); and fundamentals (4) and (5) together. For each set of fundamentals (corresponding to a sub-session of information requirements elicitation), the same procedure was used. First, edited excerpts from the fundamentals of defense included in Field Manual 71-100 (Armored and Mechanized Division Operations, September 1978) were read by the experimenter. Then all participants were given written versions of the excerpts along with sample questions and possible answers (Appendix A-3). The sample questions and answers had been generated in earlier research (Ciccone, Samet, & Channon, 1979) and participants were informed that these samples were provided for illustrative purposes only, in order to stimulate their thinking rather than to restrict it.

Next, participants were provided with numbered 4 x 6 index cards (color coded for each participant). To keep the task procedure on schedule, a 10-minute period was given in which participants were asked to write their questions and answers (one set per card). Following this question generation period, the group worked together with the experimenter to eliminate redundant questions. This was accomplished by having each participant read his questions aloud one at a time while the other participants looked over their own questions and pulled out any which were similar to the one being read. When similar questions were uncovered, the entire group would determine if in fact the questions were the same or different. If the questions were the same they were stapled together and returned to one of the originators of the question; if the questions were different they were returned to their respective question originators. During this discussion period, question wording was modified if necessary to clarify the meaning of the question.

Once all the questions were read, and redundant questions eliminated, participants were given a "Question Data Form" (QDF) to complete (see Figure 1). The purpose of the QDF was to obtain descriptive information about each of the questions and answers generated by the participants. The most vital information obtained from this form were the answers to Questions 2 and 3: Question 2 asked the participant to characterize the ability of conventional symbology (FM 21-30) to portray the specified requirement; Question 3 asked him to state whether or not he had used a personalized method to portray that requirement. Thus, these QDF responses enabled the identification of gaps in the ability of conventional symbology to portray user information requirements as well as to document the use of nonstandardized methods of portrayal. Each participant completed one form for each of his own questions, and each question-card was stapled to its respective QDF.

As indicated in Table 2, the elicitation procedure was recycled until all three sets of fundamentals of defense were covered. Following the elicitation session, participants were debriefed and asked for additional comments and insights.

QUESTION DATA FORM

EVALUATOR ROLE: \_\_\_\_\_ QUESTION NO.: \_\_\_\_\_

(1) Who would benefit most by the answer to this question? (check no more than 3 boxes)

Commander     G-2     G-3     FSCOORD     TAC Air

Other (please specify) \_\_\_\_\_

(2) From looking at a display with conventional (FM 21-30) symbology, the answer to this question is:

Obvious     Obtainable by inference     Unavailable

(3) Have you ever used your own (i.e., personalized) method (e.g., special symbol, annotation, overlay, etc.) to represent the type of information addressed by this question?

Yes     No

(4) To answer this question, which of the following sources of information would you consult? (Check all that apply)

Situation display     File     None  
 Commander     Other collection sources     Other (please specify)  
 Another staff officer     My own experience

(5) Based on your own tactical function and judgment, check one item in each box.

The answer to the question:

\_\_\_\_\_ is easy to get  
\_\_\_\_\_ is hard to get

\_\_\_\_\_ need not be precise  
\_\_\_\_\_ must be precise

FIGURE 1. QUESTION DATA FORM.

TABLE 2  
SEMANTIC FEATURES

Activity	Personnel
Air	Positions
Air Force/Marines/Navy	Procedure
Amount/Quantity	Projected
Artillery	Range/Distance
Attack/Counterattack/Penetration	Refugees/Civil Affairs
Availability	Results/Effectiveness
Behind FEBA	Reinforce
Capability	Reinforcements/Reserves
Configuration	Routes/Avenues
Corps	Smoke
Control Measures	Special Weapons
Decontamination	Status/Situation
Disposition/Location	Supporting Mission
Division	Surveillance
Drop/Landing Zones	Sustainability
Enemy	Target/Targets
Engineer	Terrain
EW/Communication	Time
Flanks	Trafficability
Forward FEBA	Unit Size
Friendly	Unit Type
Ground/Field	Visibility
Indication	Vulnerability
Logistics	Weapons/Equipment/Platforms
Movement	Weather
Objectives/Plans	Withdrawal/Retrograde/Retirement/ Delay
Obstacles	1st Echelon
Own Sector	2nd Echelon

## Information Requirements Organization

Question Classification. The output of the elicitation procedure, combined over all the fundamentals of defense that were presented, consisted of information requirements expressed as 272 specific tactical questions. Although this data base of tactically relevant information was rich in content, the form of the data base (i.e., tactical questions) was not of practical use for symbology development. A more useful organizational scheme would allow identification of the military concepts required by users as well as the dimensions of information contained in the concepts. Thus, in an effort to organize the data into a comprehensible scheme, a semantic clustering technique was developed.

The first step in the technique was to develop a set of semantic features on which questions could be described. Based on a careful examination of the question content as well as relevant military literature, 58 feature names were derived and these appear in Table 2. Appendix B contains the names as well as definitions, synonyms, or related terms for each feature. The features represent a wide range of information including distinct concepts, such as artillery and smoke as well as more abstract concepts, such as vulnerability and sustainability. Overall, the features attempt to reflect the rich content of battlefield information in a systematic manner.

Each question was examined individually and the applicability of each feature to the question was determined. Three criteria were used to determine the correspondence of a given feature to a question:

1. The feature is explicitly stated in the question, e.g., What is the current friendly available supply requirement? The features "friendly," "supply," and "availability" are all explicit in the question.
2. The feature is implicit in the question, e.g., What size and type of units are we facing? The feature "enemy," though not explicit in the question, is implicitly represented.
3. The feature is explicit in the sample answer(s) provided, e.g., Question--The 23rd Division is opposed by nine divisions, at what percent are those divisions? Answer--The three MRD are at 100% strength, the six tank divisions are at 85% strength. The categories of unit size and type, as well as strength, are explicit in the answer. This criteria was added because in many cases, as in the sample question, the answers served to clarify the information requirements of the question.

Using the criterion stated above, the number of features associated with each question ranged from 2 to 12, with a mean of 4.9, and a median and mode of 4. At the conclusion of the feature-description process each question was represented as a vector with 58 entries of 1 and 0, 1 indicating a feature applied to the question and 0 indicating that the feature did not apply.

Cluster Analysis. The next step in organizing the information requirements involved the performance of a cluster analysis on the tactical-question

feature data, to explore and uncover the structure and interrelationships inherent in the tactical questions. As a statistical technique, cluster analysis is a method for organizing and describing data and was therefore used.

In order to identify common concepts within the tactical questions, an index of similarity was calculated between questions on the basis of semantic similarity. In essence, the logic behind the procedure is that the more common the presence of specific semantic features in two tactical questions, the greater the similarity between the two questions. For demonstration purposes, a sample of part of the questions (272) x semantic features (58) matrix used to calculate similarity is contained in Figure 2. From the feature data shown in the figure, it can be seen that questions 1 and 2 are similar on three semantic features (i.e., "enemy," "personnel," and "weapons"), whereas questions 3 and 4 are similar on two features (i.e., "status" and "weapons"). Thus, based on only the five features coded here, questions 1 and 2 are more similar to each other than questions 3 and 4.

<u>QUESTIONS</u>	<u>AVAILABILITY</u>	<u>ENEMY</u>	<u>FRIENDLY</u>	<u>STATUS</u>	<u>WEAPONS</u>
(1) What is the enemy strength? (% level to battalion in personnel and equipment).	0	1	0	1	1
(2) What is the approximate fill of enemy units? (90% combat fill - weapons and equipment.)	0	1	0	0	1
(3) What is the current supply rate and is additional ammunition available?	1	0	1	1	0
(4) How many sorties of F/AC air are available and what armament do they have? (20 sorties, cannons and rockets, antitank).	1	0	1	0	1

Figure 2. Part of question by semantic feature matrix (showing four selected questions and five selected features).

An index of similarity ( $S_{ij}$ , ranging from 0 to 1) among each pair of n questions can be calculated using the formula (from Steffire, 1972):

$$S_{ij} = \frac{R_i R_j' + R_j R_i'}{R_i R_i' + R_j R_j'},$$

where the R's represent a row vector of ones and zeros for questions i and j, and  $R'$  is the column vector obtained by transposing the row vector R. These calculations are performed separately for each participant's data and yield an  $n \times n$  matrix of similarities among questions. For example, the calculated similarity (based on only 6 of the 58 features) between questions 1 and 2 and between 3 and 4 from the data described in Figure 2 are .75 and

.67, respectively. The output of this procedure was a 272 x 272 matrix of similarity measures, with each question expressed in terms of its similarity to all other questions across all 58 features. The lower triangle of this matrix served as the input to the cluster analysis procedure.

The cluster analysis was performed by a computer routine entitled "Aggregation Hierarchical Clustering Program" (Oliver, 1973). In this program, the similarity data are clustered using a technique sometimes referred to as "mean between" clustering (e.g., Andenberg, 1972). According to this method, the distance between clusters A and B is the mean of the similarities between points A and points of B. That is,

$$d(A, B) = \left( \frac{1}{n_A n_B} \right) \sum_{a \in A, b \in B} d(a, b)$$

where  $n_A$  and  $n_B$  are the number of points in A and B, respectively, and the summation is over all points a in A and b in B. This method assumes that the similarity data contain enough metric information such that the calculation of mean similarities makes sense.

#### 4. RESULTS

The semantic clustering technique resulted in seven major clusters of tactical information from the 272 questions generated by participants in the elicitation procedure. These clusters were assigned the following names to reflect the common military concept contained in each: friendly, enemy, time/capability, status, activities/procedures, terrain/routes, and plans. A discussion of the contents of each cluster is presented in this chapter and includes cluster diagrams and sample participant-generated questions. For reference purposes, Table 3 provides a summary of the cluster analysis, showing each cluster by name, the chapter-section number in which it is discussed, the frequency of questions contained in it, and a brief overview of the nature of these questions. Appendix C contains all the questions generated by the participants, listed by cluster. The final section of the chapter presents the findings of the Question Data Form (QDF) collected during the elicitation procedure.

With the clustering technique employed here, tactical questions were restricted to membership in a single cluster; in other words, questions were clustered in terms of the most similar relationships. Thus, the cluster to which a question belongs reflects the notion that the question has more in common with questions in that particular cluster than with questions in any other cluster. However, although questions appear together in a cluster on the basis of common features, questions in another cluster may also share the same features. For example, one large cluster of questions may have in common a feature such as geographic location, while another (usually smaller) cluster may also contain questions pertaining to geographic location; in the latter case, however, the questions appear in another cluster because of more prominent similarities attributable to features other than geographic location.

##### Cluster 1--Friendly Information

The military concept "friendly" is the common element contained in the 106 questions which formed the friendly information cluster (see Appendix C, page 89). Within this cluster there are two major subclusters (i.e., cluster components) with unit characteristics as the dominant element in one and geographical location information in the other. Figure 3 presents an overview of the subclusters of the friendly information cluster. Because of their size and complexity, each subcluster is discussed separately.

Subcluster 1a--Unit Characteristics. One of the most prevailing information requests in the friendly unit characteristics subcluster (Figure 4) was that of unit availability. While other concepts, such as plans and terrain-related information, appeared, availability was a more frequent theme. Within the unit characteristics subcluster there are two major branches, one dealing with air/artillery information and one related to logistics and unit-related information. The friendly air/artillery branch decomposed into two segments, namely air only information and artillery information (including artillery and artillery combined with air information). The logistics and unit-related information branch also decomposed into two segments, namely mission-relevant information and unit-related information.

**TABLE 3**  
**SUMMARY OF CLUSTER ANALYSIS RESULTS**

<u>INFORMATION CLUSTER NAME</u>	<u>SECTION NUMBER</u>	<u>FREQUENCY OF QUESTIONS</u>	<u>CONTENT OVERVIEW</u>
Friendly	3.1	106 (29%)	Friendly unit availability; air and artillery unit information; logistics information; location information about units, obstacles and reinforcements.
Enemy	3.2	81 (30%)	Identification of enemy units by size and types; unit and activity locations; type, quantity and capability of enemy weapons and equipment.
Time/Capability	3.3	22 (8%)	Time/distance for movement; time to completion of obstacles and positions; reinforcement capability (for enemy and friendly).
Status	3.4	20 (7%)	Current situation concerning: communications; positions; roads; weather; trafficability.
Activities/Procedures	3.5	18 (6.5%)	Special weapons employment and procedures; indications of enemy activities; refugee activities.
Terrain/Route	3.6	15 (5.5%)	Identification of useable routes, avenues of approach, obstacles; terrain overview.
Planning	3.7	10 (4%)	Enemy objectives; defensible terrain; engineer plans.

272

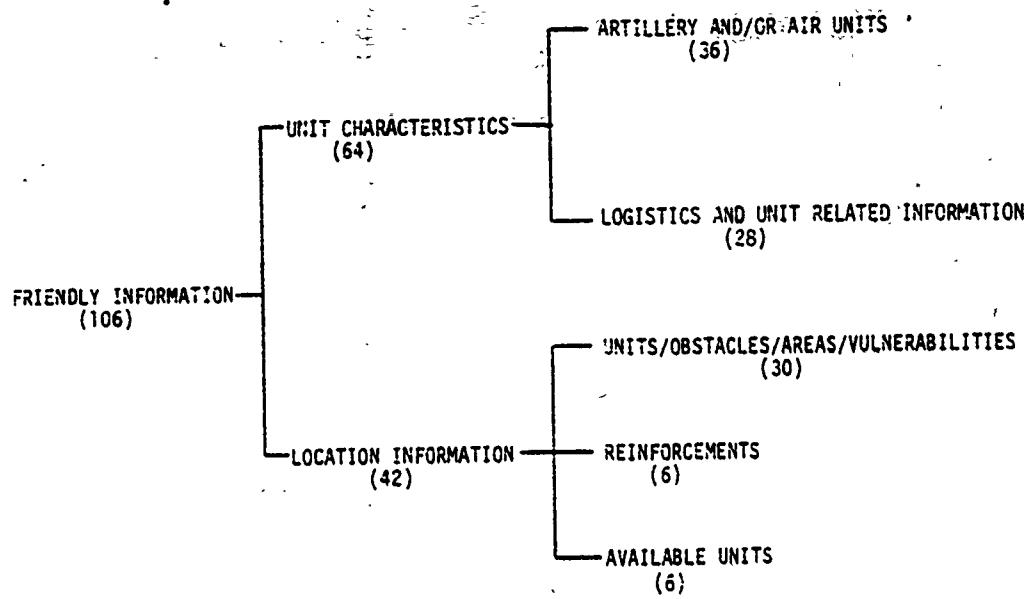


FIGURE 3. FRIENDLY INFORMATION CLUSTER.

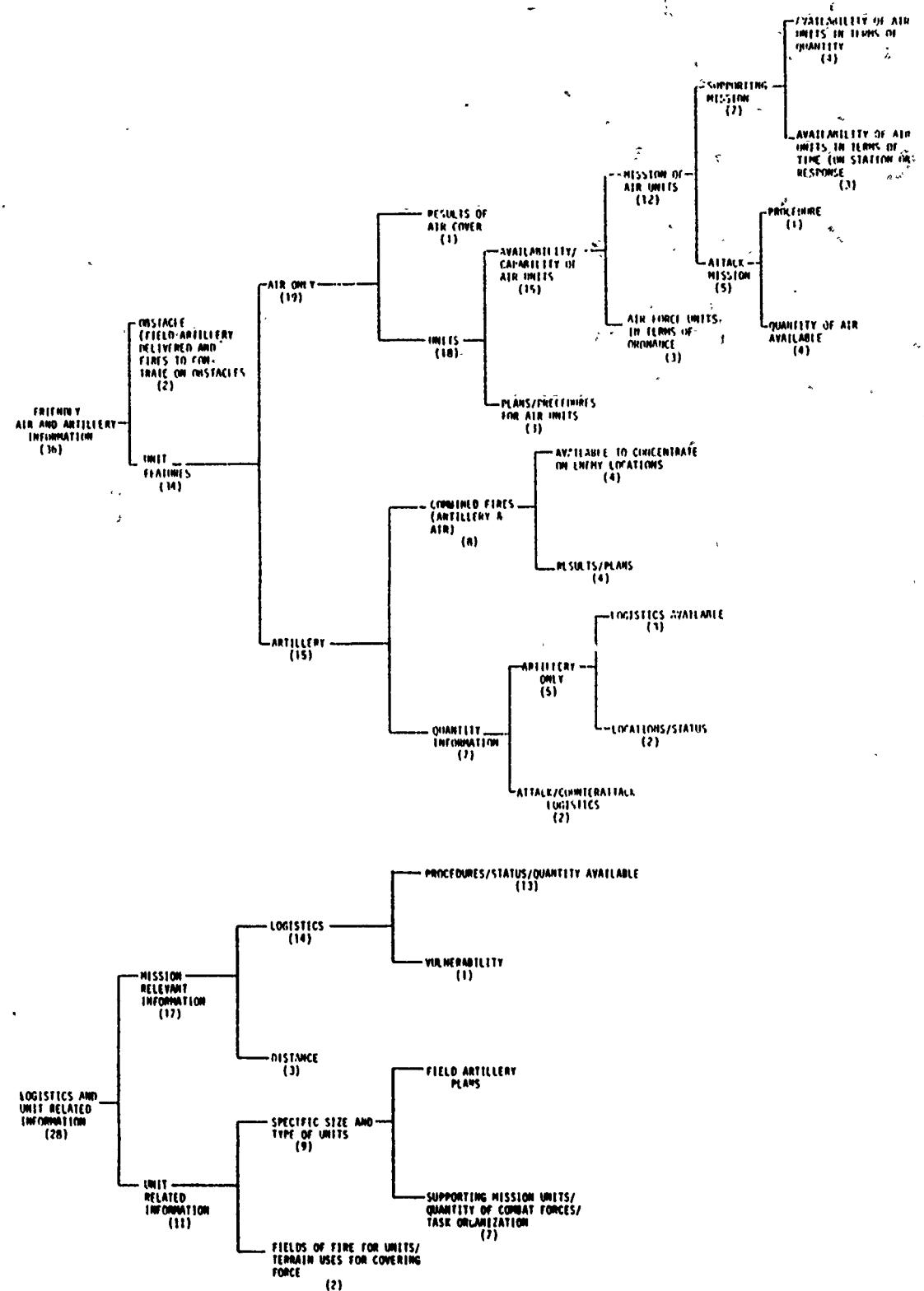


FIGURE 4. FRIENDLY UNIT INFORMATION SUBCLUSTER.

Inspection of the air/artillery branch of the friendly unit information indicates the range of information requested by users. The following are a sample of the questions contained in the "air only" segment of the branch; some sample answers, when supplied by users, are given in parentheses.

What air force support is available--sorties per day? (10-15)

What TAC air other than our organic close air support do we have available now to strike at the enemy's brigade? (Number of sorties and time on station)

What antitank helicopter capability do we have? (10 aircraft)

How many sorties of TAC air are available and what armament do they have? (20 sorties, munitionsocket, antitank)

What is the tactical air/attack capability? Reaction time? Reaction Ordnance?

Does the Division have its attack helicopters in general support (GS) or direct support (DS) of brigade? (Initially in GS under Division troops with priority to 2d Bde, 3d Bde, and 1st Bde)

From these few examples, it is evident that users require availability/capability information about air units; that is, 15 of 18 air unit questions concerned the availability/capability dimension. Further, users requested answers which were in terms of quantity of craft or time on station or response time. Specifically, 13 of the 15 air availability/capability questions requested an answer in time or quantity.

Concerning artillery information, some questions dealt with combined air and artillery fire while others were related to artillery alone. The following are examples of the questions found in the artillery segment of the air/artillery branch:

What friendly fires can be massed on enemy penetration? (artillery, TAC air)

What are the results of our fire support use?

What is the ASR (available supply rates) for field artillery ammunition? (20 rounds per tube per day)

What is the status of our air defense forces? (locations, strengths, and ammunition availability)

What percent of the TAC air and field artillery ammunition will we allocate to various phases of combat? (Save a minimum of 30% of resources for a counterattack.)

The artillery information required by users represented a considerable range of information. The eight questions dealing with combined fires requested information concerning fire availability as well as results of fires and fire support plans. The remaining seven questions were seeking quantitative information, such as the amount of available ammunition.

The second major component of the unit information subcluster, entitled logistics and unit-related information, contained 28 questions. Half of these questions were concerned with a range of logistical information, such as the following:

What is my ASR (availability supply rates) for all types of ammunition? (155mm-, 8mm-, ADA-)

Are there any restrictions on ammunition supply rates? (4.2" and 81mm are in short supply--80 rounds per day per tube, all other unlimited.)

What is the status of resupply to the Division of class III, V, and VII? (gallons per day of class III, number of rounds of class V, and number of tanks, etc.)

Will my supply procedure be manual or ADP? (ADP)

What is the policy on exchanging deadlined combat vehicles with existing theatre stocks? (as required)

What is the current status of friendly forces in terms of major end-item availability/serviceability? (list of losses/projection of supply to units)

Common to a number of the questions was that the answer involved quantitative information; yet others were related to procedures or policy. Within this same subcluster there were questions concerning other aspects of unit information, such as the following:

Are special weapons available and in range of the main attack? (155mm-3, 8"-2, both--chemical)

What is the friendly field artillery order of battle? (a Corps group--by the type battalion--supporting the Division and tactical missions assigned to it and organic units)

What engineer support is available to dig in and construct fortification? (one combat engineer battalion)

What is the mix of combat forces now committed in each area? (two armor, one infantry--1st brigade)

Where are the fields of fire? (tanks, TOW, DRAGON, small arms)

What are the terrain uses for the covering force?

This grouping of information requests required a large range of varied types of information, including current dynamic information, such as availability as well as more static information concerning the terrain.

Subcluster 1b--Location Information. The second subcluster (42 questions) of the friendly information cluster contained the common element of location information. Figure 5 provides an overview of the subcluster.

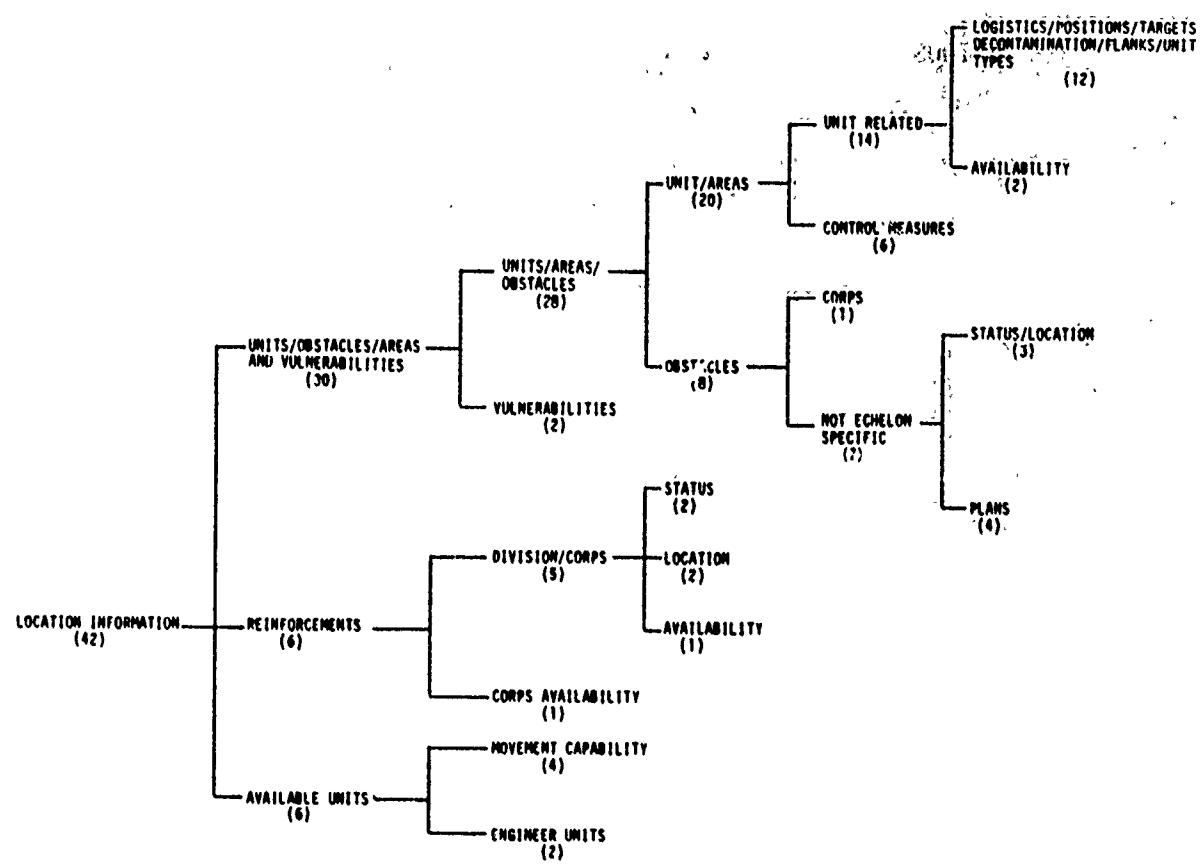


FIGURE 5. FRIENDLY LOCATION INFORMATION SUBCLUSTER.

Thirty questions dealt with location requests for a variety of different units as well as areas, for example:

If I reinforce outside sector where are the coordination points?  
(coordination point PV116111)

What is the current location of ammunition supply points? (locations by coordinates)

Where are areas that can be used to decontaminate vehicles and equipment? (fire pond located PV116117)

Where are the friendly units to company level? (six-digit coordinates)

What types of surveillance means are available and where are they? (locations of observers, radar-counter artillery, personnel, RECCE, photo, electronic)

Where are my obstacles placed? (locations)

From this sample it is evident that a wide variety of information related to location is required, most of which can be answered in terms of grid coordinates.

The remaining 12 questions in the location cluster dealt with the location of reinforcements and available units. For example:

Where are Corps artillery assets in the Division area and those in other areas that can support the Division?

Where is the Division reserve located? (coordinates)

What Corps units are available for use in the Division sector and what are their reinforcement times? (list of units and times)

Can Corps provide reinforcements if necessary--where are they currently located? (yes, one division (-) in reserve, 1½ hour march time away)

What additional tank obstacles can be emplaced by combat engineers on major avenues of approach in the south to slow enemy advance? (can knock down trees blocking all routes through forested area x)

Can our units dig new defensive positions, prepare obstacles on major enemy avenues of approach to rear of current defensive lines--what engineer support available? (Division engineer battalion can put priority on effect in x area.)

For this set of questions, sample answers were again given in grid coordinates. However, a few questions concerning the movement of units, such as reinforcements, required an answer expressed in units of time.

## Cluster 2--Enemy Information

The concept of "enemy" was the common element for 81 questions contained in the enemy information cluster, which is described in Figure 6. This cluster contained two major subclusters, one which related to area/units and activity and a second which pertained to weapon and equipment information.

Subcluster 2a--Areas/Units and Activity Information. This subcluster contained 65 questions concerning areas/units and activity information. Here are some examples:

With what type and size units will the enemy move into our sector?

What are the latest enemy locations and enemy configurations of units?

Where are the potential drop zones in the area for enemy airborne operations? (vicinity \_\_, etc. with size and troop capability)

From what enemy locations are most electronic emissions radiating?

Where are enemy air strikes concentrating?

At what point is the enemy most vulnerable? (vicinity \_\_ due to restriction of narrow front)

The prominent enemy information requested in this subcluster concerned grid coordinate locations and the identification of types of enemy units. Though concepts such as capability and strength were requested, the frequency of these requests was not high.

Subcluster 2b--Weapons and Equipment Information. This second subcluster of enemy information contained 16 questions about weapons and equipment. The following are sample questions from the subcluster:

What is the enemy strength? (% level at battalion in personnel and equipment)

What is the enemy bridging capability? (The enemy has 14 mobile bridges.)

What are the specifics on the major equipment of the opposing force? (Armor T-72, T-60, T-54; strength)

Does intelligence report any large amount of artillery ammunition being moved forward? (Total amount of artillery projectiles reported in the area opposite our forces is greater than the unit's capability to carry--indicating preparation for attack.)

Where is the enemy stockpiling POL?

What type of enemy field artillery is there? (standard Soviet organization, 120mm, 152mm, etc.)

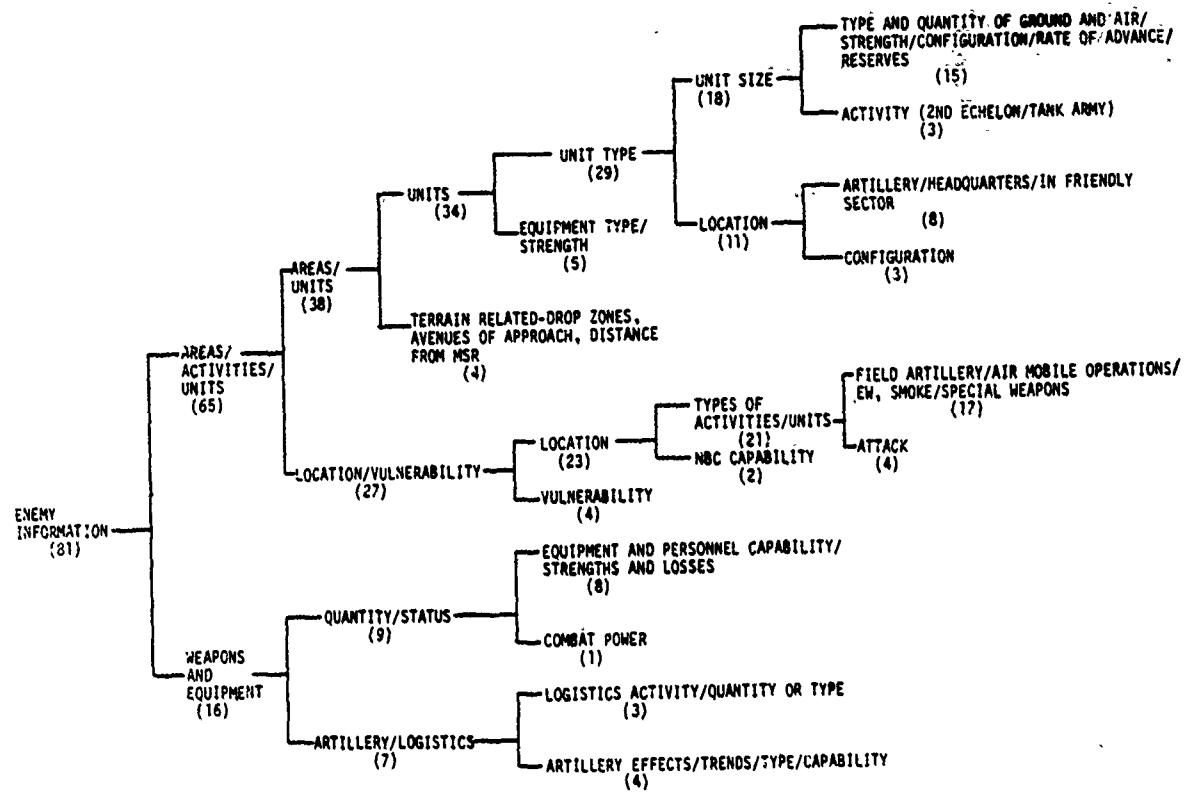


FIGURE 6. ENEMY INFORMATION CLUSTER.

Have any trends been established by the enemy in the use of his fire support? (command and control field artillery, etc.)

The questions ranged considerably from concerns about enemy trend information to quantity information about specific equipment. Of the 16 questions, 7 requested information concerning enemy capability or strength.

#### Cluster 3--Time/Capability Information

The cluster of information in which the common elements were time and/or capability consisted of 22 questions. Figure 7 shows the branches of the cluster and the following represent sample questions:

What are my day and night time-distance factors for movement (forward, back, and laterally)? (Show times by T+.)

What alternate/subsequent battle positions are available, are they prepared--when will they be prepared? (for each battalion and artillery battery, no, 3 days)

For how long can the enemy sustain combat operations on a continuous basis in my sector? (for 72 hours)

When will the 1st echelon attack? (measured in time--hours and minutes--or a "gate" of time)

What is the enemy capability to employ high performance aircraft? (17 sorties of MIG 21 in my sector per day)

What is the enemy current rate of movement and capability to increase? (10-15 km/hr on particular axis increases to 20-25)

Within this cluster, answers were expressed in time units for 20 of the 22 questions. For some questions, time was used to estimate movement distance. In other questions, time pertained to estimates of completion or provided the time frame for unit employment or reinforcement capability. Out of 9 questions requiring unit capability information, 7 requested time frames in the answer as well as unit information, while 2 questions were concerned with ground movement capability and did not request time information.

#### Cluster 4--Status Information

The common element among the 20 questions in this cluster was the request for status (i.e., current situation) information. This cluster is shown in Figure 8, and the following are sample questions:

What is the communication capability and status? (net status--who can talk)

What is the status of prepared blocking or secondary positions? (60% complete)

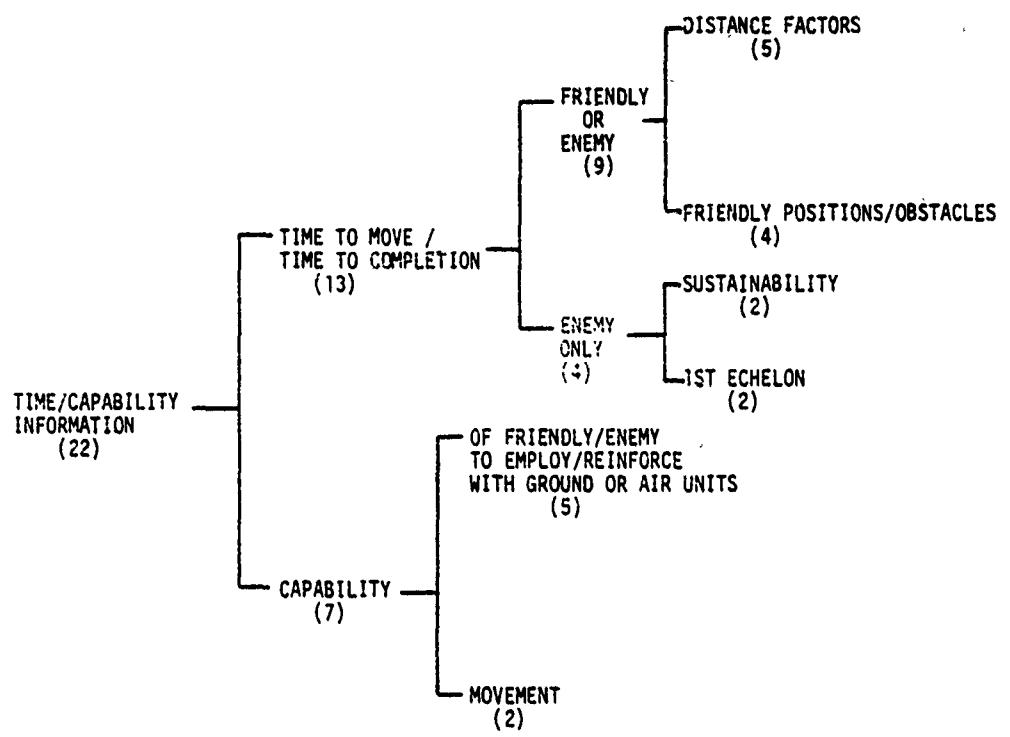


FIGURE 7. TIME/CAPABILITY INFORMATION CLUSTER.

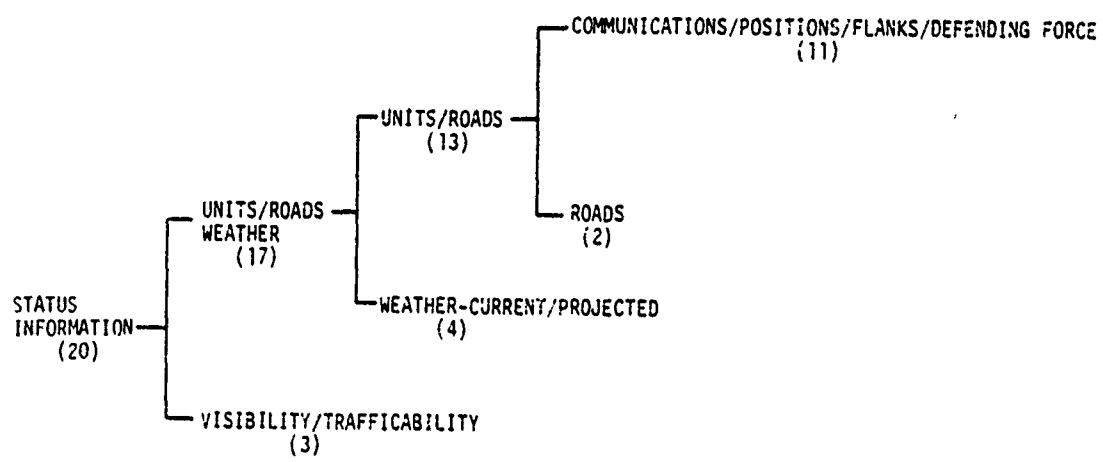


FIGURE 8. STATUS INFORMATION CLUSTER.

What is the situation on the Division's northern and southern flanks? (trace--enemy and friendly)

What is the status of the defending/delaying forces in the bridges actually executing the covering force mission? (locations)

What is the situation regarding roads and trafficability? (roads clogged, bridges out, etc.)

What is the current weather and predicted effects? (temperature and wind direction)

The types of answers requested by participants varied with the inclusion of lists of units (for net status), numbers (for temperature) as well as location information.

#### Cluster 5--Activities/Procedures Information

The concepts of either activities or procedures were common elements of the 18 questions contained in this cluster. Figure 9 provides an overview of the information organization of this cluster, and the following are a few sample questions:

What are the indications of enemy activity? (They are in attack formations and could attack in 12-24 hours.)

How many of my units are engaged? (2/3)

Have any special weapons been employed, if so, what kind and where? (number of weapons, bv types, etc.)

What is the time required to get friendly release of special weapons? (40 hours)

Has smoke been authorized for use? Available? Used? (from battalion FSO)

What is the civilian occupation of critical built-up areas--size, activity? (HAHN vicinity \_\_, 50% preparing to evacuate)

From this sample of questions, it is evident that requests for activity or procedure information may be answered in a number of ways, including reference to time, types and numbers of weapons, as well as location data.

#### Cluster 6--Terrain/Route Information

This cluster, in which the common element is terrain or route information, consisted of 15 questions. Figure 10 provides an overview of the information structure and the following are sample questions from the cluster:

What are the avenues of approach? (direction in relation to major terrain features and our key terrain)

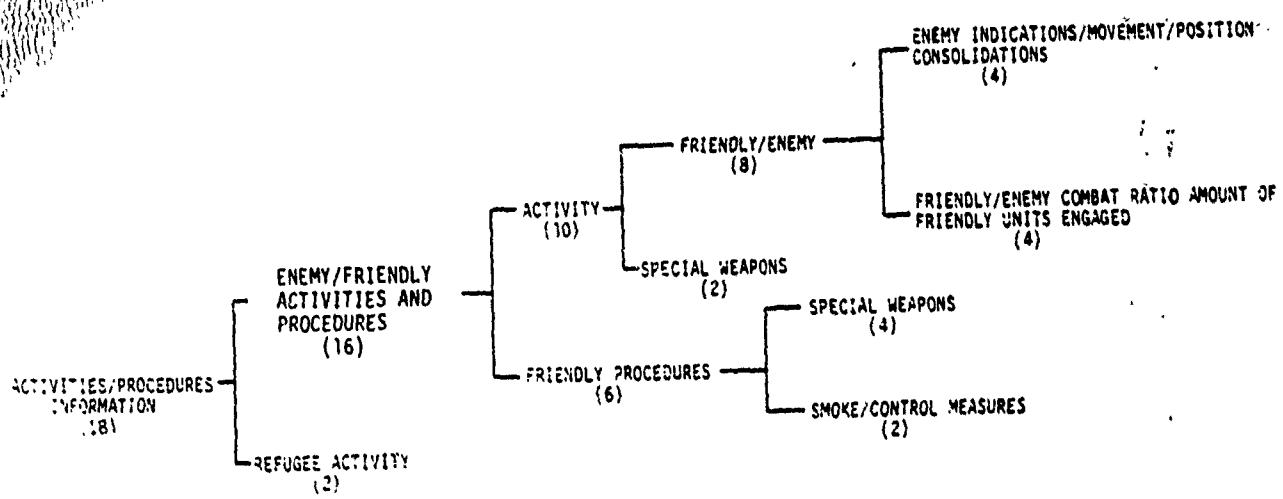


FIGURE 9. ACTIVITIES/PROCEDURES INFORMATION CLUSTER.

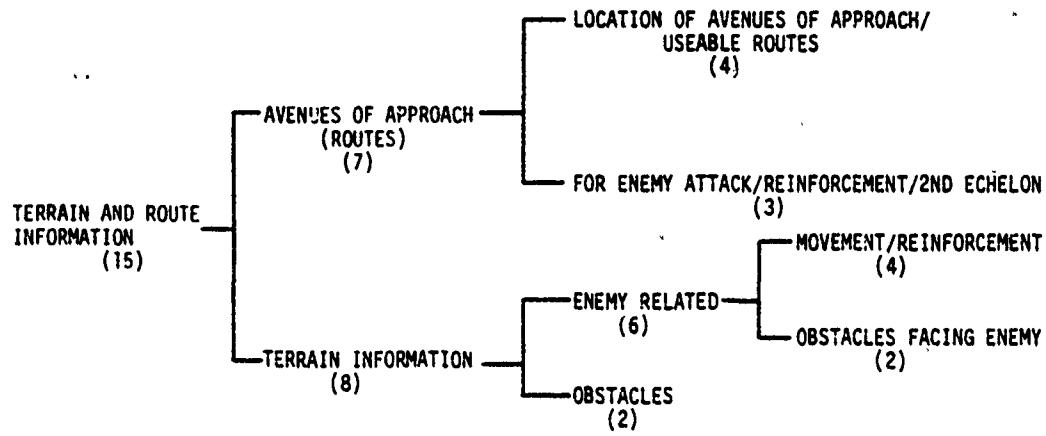


FIGURE 10. TERRAIN/ROUTE INFORMATION CLUSTER.

What are the usable routes for friendly movement? (route, direction, trace)

What are the likely routes along which the enemy will commit 2nd echelons? (high speed avenues of approach)

Does the terrain lend itself to the enemy to reinforce his breakthrough? (yes, both from the south and the north--reinforcement ability based on the terrain)

What are the natural barriers or obstacles facing the enemy? (mountains, ravines, streams, rivers, bridges)

What obstacles are critical to movement, MSR, reinforcement, etc.? (bridges, restricted roadways, swamps, etc., without bypass)

The questions contained in this cluster pertain to map information. However, most of the questions could not be answered with a hard copy map alone. For example, the usability of routes may change over time, and avenues of approach are identified according to the size of units they can support. Thus, survey participants appear to be requesting updated and/or processed information.

#### Cluster 7--Planning Information

The concept of planning is common to the 10 questions contained in this cluster. An overview of the cluster may be found in Figure 11; the following are sample questions contained in the cluster:

What is the enemy's tactical doctrine? (frontal attack, penetration, deep objectives)

What terrain is most defensible?

What is the Commander's concept of the defense? (strong in center, economy force in south, counterattack exposed flanks and to destroy enemy formation, covering force do not become engaged)

Is any area designed for preplanned TAC NUC? (DGZ with minimum safe distance and strike warning time)

What route priorities have we assigned to artillery units in order to facilitate rapid movement and responsive support? (outline of priorities by unit)

Within this cluster, the answers varied from relatively static and objective answers concerning enemy doctrine to changing information concerned with friendly tasking priorities.

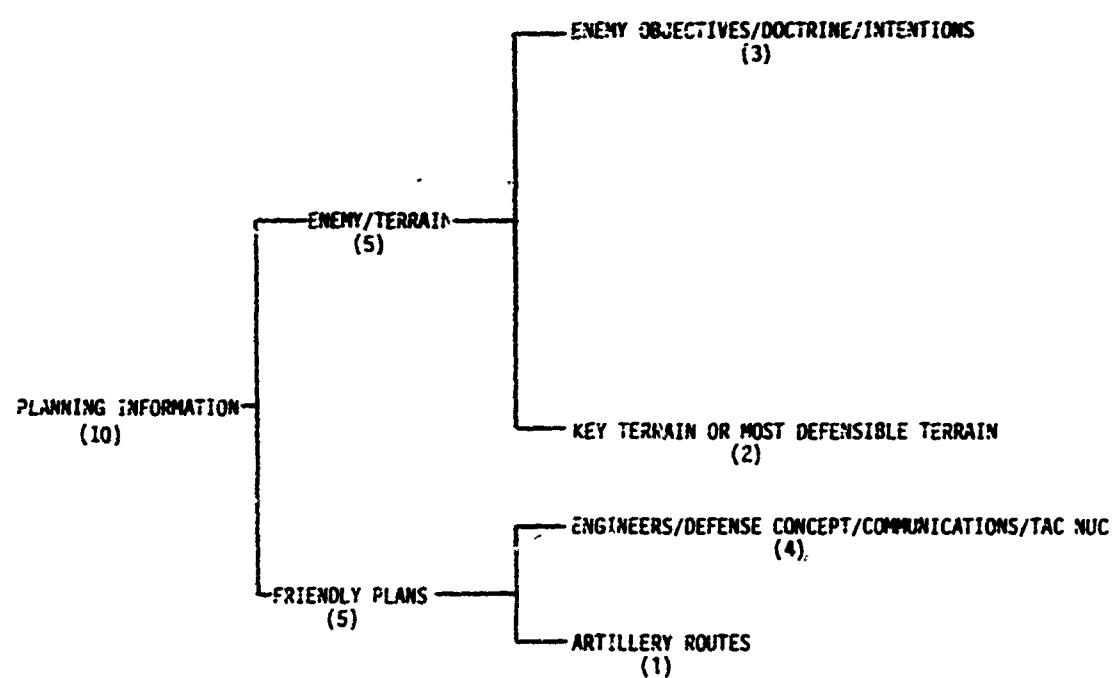


FIGURE 11. PLANNING INFORMATION CLUSTER.

### Question Characteristics

During the elicitation sessions, participants were asked to complete a Question Data Form (QDF) for each of their questions. One of the questions on the QDF asked participants to characterize the given information requirement as either obvious, obtainable by inference, or unavailable from a display with conventional symbology. Obvious information is easily understood from a display with conventional symbology, and would include, for example, unit type (e.g., armor, infantry). Information which is characterized as obtainable by inference implies that some of the information is portrayed but not in a complete or easily recognized manner; for example, the type of equipment contained in an enemy unit might be inferred based on additional information, such as an Order of Battle file. The third category dealt with information requirements which are not portrayed or derivable from a conventional display, for example, friendly available supply routes (ASR).

Table 4 provides a summary of the results of the QDF responses for the questions contained in each of the seven clusters of information identified by this analysis. The table gives the number of questions contained in each cluster as well as the percentage of questions which survey participants characterized as either obvious, obtainable by inference, or unavailable from a display with conventional symbology. The final column in the table lists the percentage of questions in the cluster for which participants noted that they have used a personalized method to portray the answers.

The two clusters which contained major subclusters are also decomposed in this table. For example, consider the unit characteristics within the friendly information cluster. For the branch dealing with air/artillery (number of questions,  $n = 36$ ), the required information was said to be obvious from a display with conventional symbology for 6% of the questions. Users responded that answers to 64% of the questions are unavailable from a conventional display. Further, users said that they have portrayed the necessary information with personalized methods in 53% of the cases. Looking at the branch dealing with logistics and unit-related information ( $n = 28$ ), the picture isn't much different. While the users noted that 18% of the information is obvious from a display with conventional symbology, 71% of the information was judged unavailable; and for 68% of the questions, survey participants said they have used personalized methods to represent the information.

The second subcluster of friendly information contained 42 questions related to location. The results of the QDF analysis revealed that for 50% of the location information answers were considered obvious from a display with conventional symbology. Only 22.5% of the needed information was classified as unavailable from a display. However, respondents noted the use of personalized methods of portrayal for 40% of the location information. For the enemy information subclusters, the same type of analytical comparisons can be made.

As another example, the third cluster of information requirements related to time/capability ( $n = 22$ ). From the QDF results we see that only 9% of this information was indicated by participants to be obvious from a conventional display, and 45.5% of the information was considered to be

TABLE 4  
SUMMARY OF QDF RESPONSES

INFORMATION CLUSTER NAME	NUMBER OF QUESTIONS	From a display with conventional symbology, the information is:			Survey participants have used a personalized method to portray requested information
		OBVIOUS	OBTAINABLE	UNAVAILABLE	
1. Friendly					
a. Unit					
Air/Artillery	36	18%	11%	64%	53%
Logistics and Unit-related	28	6%	30%	71%	68%
b. Location	42	50%	27.5%	22.5%	40%
2. Enemy					
a. Areas/Unit and Activity	65	48.3%	32.3%	19.3%	44%
b. Weapons and Equipment	16	12.5%	25%	62.5%	25%
3. Time/Capability	22	9%	45.5%	45.5%	36%
4. Status	20	15%	15%	70%	45%
5. Activity/Procedures	18	17%	28%	55%	50%
6. Terrain/Route	15	7%	72%	21%	64%
7. Planning	10	20%	30%	50%	40%

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unavailable. Personalized portrayal methods were said to have been employed by participants for 36% of the information contained in the cluster. As indicated in the lower portion of the table, the QDF results for the remaining clusters of status, activity/procedure, terrain/route, and planning information are described in a similar fashion.

The histogram in Figure 12 provides an overview of the results of the QDF for all of the participant-generated questions. Among the 272 questions, participants considered the answers to only 27% of them to be obvious from a display with conventional symbology and 43% to be unavailable from such a display. Furthermore, the data indicate that the use of personalized methods to portray required information is widespread. Not only have personalized methods been employed for information which is said to be unavailable, but personalization has even been used for portraying information which is said to be obvious from a display. This latter finding is both interesting and perplexing; the indication is that even information which is obvious from a display requires modification in some cases to fit the specific needs of the user. Overall, these data reveal a significant gap in the ability of conventional situation displays to provide users with required information, and also that users will in many cases attempt to fill this gap in their own way.

 PERSONALIZED METHOD  
USED TO REPRESENT  
INFORMATION

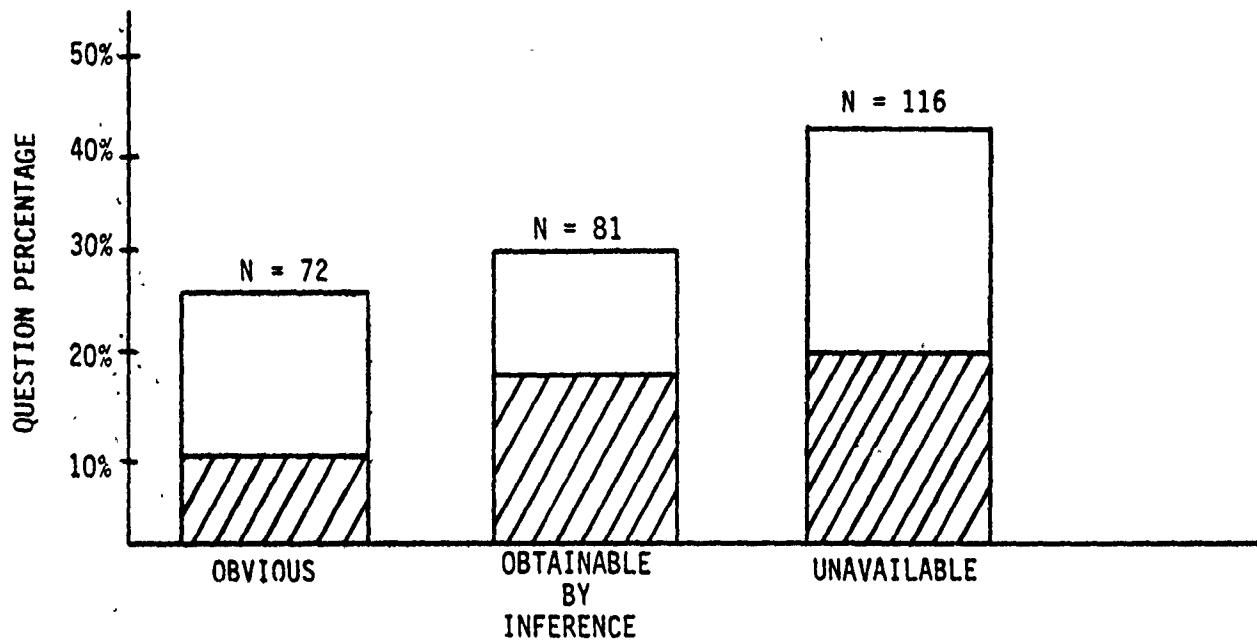


FIGURE 12. GRAPHIC STATUS OF POTENTIAL ANSWERS.

#### 4. DISCUSSION

##### Introduction

The primary objective of this research effort was to conduct a preliminary investigation into the symbology needs of Division level Army personnel, and to assess the adequacy of conventional symbology (FM 21-20) for fulfilling these needs. To meet these objectives, workable techniques were developed to elicit user information requirements and refine and organize them into a preliminary data base. The elicitation procedure was employed successfully with military personnel serving as participants. The elicited data resulted in 272 user-generated tactical questions, for which descriptive data were obtained concerning the graphic portrayal of the information associated with the potential answers to each question. In particular, a determination was made of the degree to which answers are considered available from conventional symbology or are generated by personalized portrayal methods. This information served to identify the gaps between user-required information and the capability of conventional symbology to portray the information. For example, it was found that very little friendly unit information is obvious from a conventional display, and more than half of the needed information is said to be portrayed by users with personalized methods.

As with any language, tactical terminology is not completely standardized, and subtle differences between words may reflect vast and meaningful differences to tacticians. This research effort, therefore, attempted to capture meaningful distinctions as well as to integrate similar concepts. With this purpose in mind, a semantic clustering technique was developed for organizing the tactical questions to identify key concepts underlying the structure and content of the information. Overall, the application of the cluster analysis technique proved successful in identifying several distinct groups (i.e., clusters) of information that had specific, meaningful military concepts in common.

##### Conventional Symbology and User Information Requirements

Traditionally, conventional symbology has served a communicative function, providing users with such information as unit type and size, as well as identification, principal weapon systems, and locations. For these purposes, conventional symbology seems adequate. In this spirit, FM 21-30 offers the following guidance for military symbology:

...operational personnel and instructors should strive to depict only essential information. Simplicity, uniformity, and clarity are the keys to good symbology.

Thus, a symbol set, representing essential information in a simple, clear, and uniform manner, probably would be ideal.

However, the results of current research indicate that user information requirements extend well beyond the scope of conventional symbology. That is, the battlefield does not seem to be portrayed adequately by unit functions and designators alone. Further, the proliferation of personalized portrayal methods indicates an attempt by users to represent the

information in one way or another in order to compensate for the inadequacies of conventional symbology. That is, when users do not have a standard method for portraying additional information, they will, in many cases, develop their own method. While this inventiveness may serve as a practical solution for individual needs, the lack of standardization can lead to communication difficulties and even misunderstandings among users. Furthermore, as new automated data processing systems are fielded with greater potential for rapid transfer of graphic information within and between command groups, these difficulties can be expected to increase. In general, therefore, improved standardized techniques of graphic portrayal are needed.

Dynamic Information. The cluster analysis of information requirements and the results from the corresponding Question Data Forms (QDFs) revealed a number of areas where displays with conventional symbology are not providing users with the information they need. These gaps are clearly evident with regard to dynamic tactical information, especially within the context of the "friendly information cluster." Existing symbols for friendly unit information fall short of satisfying user requirements; for when a user requests information about his own units, he is looking for much more than unit type, size, and designator. The user is seeking information that is relevant to his decision-making needs. For example, he wants to inquire about unit availability and capability, the results of actions, unit deployment plans and procedures, as well as the current status of logistical support. As one might predict, answers to questions about location information are obvious from a display with a greater frequency than are answers to questions concerning unit information. Yet, even the required friendly location information was said to be obvious for only half of the questions, possibly because user requests for availability, status, or movement-capability information were often combined with location-related requests.

Information requests related to enemy areas/units and activity within the "enemy information cluster" fare much better with respect to current graphic portrayal methods than friendly unit information. Nearly half of the user-requested enemy information was considered to be obvious from a conventional display; this is probably attributable to the fact that half of the questions required enemy location information. There were, however, requests for dynamic types of information about the enemy posture as well as for enemy strength, capability, vulnerability, and rate-of-advance information that are not generally obvious on the display. When users requested specific information concerning enemy weapons and equipment, they found only a small amount of the information obvious on a conventional display.

The requirement for dynamic information also is apparent in the remaining clusters of tactical questions. For example, in the time/capability information cluster, the capability to employ or reinforce with specific types of units represents information needed about both the friendly and enemy forces. In the "status information" cluster, the concept of current status is applied to roads and weather as well as communication nets, and a majority of this information is unavailable on a conventional display. Or, as shown in the "planning information" cluster, users requested information concerning friendly force plans and procedures as well as types of enemy activity. It is evident, therefore, that a variety of dynamic

information is requested by users, and that only a small amount of it is obvious from a display.

Indications from this preliminary data gathering effort point to the fact that users have a need for situation displays that can capture the dynamic aspects of a rapidly changing battlefield. This information can range from an identification of impassable roads to a discrimination between friendly units within communication contact and those without. For example, comments from survey participants noted that logistical information, such as available supply routes and ammunition allocations for phases of combat, should be portrayed on a display. Other comments expressed the need for a system to selectively or collectively display artillery range fans for both enemy and friendly units. One participant noted that merely indicating that a field artillery unit was functioning in the rôle of direct support (DS) or general support (GS) would be extremely useful.

Dimensions of Required Information. The formulation of guidelines for the graphic portrayal of the battlefield requires identification of the relevant dimensions of user information requirements. The results of the cluster analysis performed here can provide guidance in this endeavor. The reader should recognize, however, that the dimensions to be discussed are, at this stage, tentative and based on a relatively small sample of users and one specific scenario. Future research will be required to increase the number of scenarios as well as to sample a larger number of users.

Availability and Capability. From the analysis of friendly unit information, the concept of availability appears to be a key concern; in other words, the user needs to know whether or not a specific asset is available. This concept is considered when decisions must be made concerning the optimum usage of battlefield assets. If availability were to appear on a display, the question of what information it should convey becomes important. From this survey, it is evident that users are looking for more than binary (i.e., yes-no) information. For example, concerning the availability of friendly air units, users want an answer in terms of the quantity of craft (or number of sorties) or their time on station/response time. Concerning logistics, users may request details such as fuel consumption in gallons per day. Quantity and time, therefore, appear to be relevant dimensions of user requested availability information whose display should be given serious consideration. However, from this limited sample it cannot be concluded that portrayal of unit availability could be handled exclusively by providing quantity or time information.

The concept of unit "capability" is an important aspect of both friendly and enemy forces. Generally, requests for capability information involve dimensions similar to those pertaining to availability. Based on this preliminary survey, participants appear to use availability and capability as interchangeable terms. Whether these concepts could or should be portrayed by the same dimensions of information, however, requires further investigation.

Time. The requirement for time information was not limited to availability and capability requests. For example, distance information was sometimes referred to in terms of time, implying that the amount of time necessary for units to move may be more relevant than actual distance per

se. Concerning enemy activities, time is an answer to sustainability as well as to when an attack is expected. An answer in time is used frequently to indicate the expected completion of friendly obstacle emplacement and position readiness. Conventional symbology does provide a standard method for indicating proposed obstacles and positions, namely, a "dashed line." However, this use of a dashed line conflicts with at least one existing symbol (i.e., that used to show mine clusters) which is also formed with a dashed line. Returning to the time issue, conventional symbology does not have a standard method for noting the projected time of completion for positions. Thus, standardization of improved portrayal procedures might permit users to easily display and understand time-related information.

Status. Looking through the cluster of status information in detail, certain dimensions are apparent for small groups of related questions. For example, communication status is important and may be portrayed in a binary fashion, i.e., through differentiation between units with functioning communication links and those without. Such information may be indicated by simple binary coding, possibly by use of highlighting. Attention should be given to the information in this cluster since a large amount of it is unavailable on a conventional display, and nearly half of the information currently is portrayed through personalized techniques. Additional surveys of tactical personnel may help to identify the required dimensions of information.

Activity. Activity, along with procedure information, formed only a small cluster of questions that involved a variety of information dimensions. Some of these dimensions, such as type and location of employed special weapons, are portrayable with conventional symbology, which provides a few symbols for specific battlefield activities, such as ambush, fire-fights, and harassing fire. Others, however, such as combat ratio and indications of enemy activity, do not have a standard method for portrayal. Since this cluster of activity/procedure information was relatively small, further data are needed to identify important common information features that may be present.

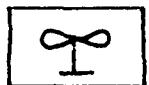
### Conclusions

Frequent users of conventional symbology are not likely to be surprised by the present research findings; the shortcomings of conventional symbology probably have been apparent to most users for some time. As stated earlier, no attempt was made in this research effort to distinguish between information requirements that could or could not, or should or should not, be portrayed in graphic displays. Thus, there is the possibility that many of the user information requirements specified do not lend themselves to convenient graphic display; some, for example, might be more usable in a hard copy tabular form. Further, certain user-desired information may be displayable by modifications to existing symbology, while other information may require a new symbol.

One of the most important features of the cluster analysis employed here, therefore, is its utility for enabling the matching of user required information with the information currently portrayed by conventional symbology. For example, the branches in the cluster analysis show that

conventional symbology falls short of information needs. Looking at the air/artillery branch of friendly unit information, it is clear that conventional symbology does allow differentiation between air and artillery units. However, if the user wants information that is farther down in the tree, such as the availability of units, it may not be found on a standard display. This is not to say that a new symbol is required to show unit availability. Instead, conventional symbology might be modified to reflect unit availability information.

To illustrate, consider the dimensions of quantity and time that are important to the portrayal of availability information. As an example, the following symbol modification might be used to indicate the availability of 15 attack helicopters per day:



15 AH/DAY

This example is not intended to signify a definitive portrayal technique, nor is it suggested that such information fulfills all user requirements concerning availability. Rather, the point to be stressed is that some user requirements may be satisfied by simple modifications to conventional symbology, and there are probably numerous effective modification techniques already in use by personnel who have created their own way of displaying specific information requirements.

Furthermore, various symbol modification techniques are becoming available with automated graphic display systems that could provide the user with more detailed information while avoiding the clutter problem inherent in the display of additional information. For example, automated systems can provide selective, call-up displays that allow the user to access specific information only as needed. Such systems can offer zooming and declutter capability and various coding manipulations through the use of size, color, shading, density, flashing, perimeter highlighting, etc. Such techniques appear worthy of systematic exploration to arrive at new standards and guidelines for enhancing understanding among users.

This research effort has documented some of the major deficiencies of conventional symbology and constructed a preliminary data base of information requirements. A more comprehensive data base should include input from a larger sample of users, with emphasis placed on active field personnel with a wide range of tactical knowledge and expertise. In addition, future research should include an offensive as well as a defensive scenario and should cover both Middle Eastern and European terrain. Whether the ultimate goal is modification of conventional tactical symbology or the development of a new improved symbol system, a comprehensive data base of user information requirements will provide an essential building block.

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**APPENDIX A**  
**RESEARCH MATERIALS**

APPENDIX A-1  
INTRODUCTION FOR SURVEY PARTICIPANTS

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INTRODUCTION TO FIELD SURVEY

**PERCEPTRONICS**

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## BACKGROUND

Perceptronics is currently working with the Army Research Institute on a continuing project dealing with the "Graphic Portrayal of Battlefield Information." The ultimate goal of this project is the development of preliminary guidelines to improve and make more effective the graphic representation of the battlefield situation. Currently, the visual display of the battlefield environment consists of a map and overlay containing conventional symbology (FM 21-30 and FM 71-100). This method of display is generally abstract, cluttered and static in nature. The graphic systems of the future are likely to have the capacity of displaying information selectively and in a dynamic manner, with rapid updating, zooming capabilities, pulsation and the like. If such advanced systems are to be of value in the coming decades they must satisfy the changing battlefield information needs of the user.

## CONVENTIONAL SYMBOLOGY

The first year of this research effort focused upon the development of a method for determining the information requirements of users. A role-playing exercise was developed for eliciting information requirements from experienced military tacticians. These staff officers were assigned a TOC user role (e.g., G-3 section duty officer) and given a tactical function to perform (e.g., recommend friendly troop deployment against potential enemy threat). The participants would then enumerate the information that they would require to complete their function. The exercise was conducted with a limited number of staff officers and tasks; however, some insights concerning conventional symbology and the modern battlefield became apparent. More specifically, although conventional symbology can convey basic unit information (e.g., identity, function, size and weapon type), it cannot communicate a richness of detail.

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considered important by command personnel, and it cannot accomodate most of the new "imperatives" of tactical doctrine (e.g., combined arms forces, unit threat, etc.). Such parameters of information appear to be necessary for supporting modern tactical performance.

#### CURRENT OBJECTIVES

While a great deal was learned from the first year effort, there is still more to be done. Phase II of the project will continue to uncover the information requirements at the Division TOC level. The objective of this phase of the research effort is to translate current and developing doctrine into practical guidelines for the graphic portrayal of battlefield information.

#### ADVANCED TACTICIANS AND EXPERIENCED STAFF OFFICERS

A research effort such as this cannot achieve its goal in isolation. The input of military expertise is essential! We have, therefore, sought out individuals within the military community, like yourself, who are knowledgeable about the division TOC operations as well as up-to-date on current and developing doctrine. To take advantage of your expertise, we are conducting structured interviews within a small group setting. Each group consists of staff officers, all of whom have a specialty or experience relevant to TOC information processing and decision making.

#### PROCEDURE

In order to determine the information requirements of the TOC staff, we will be using an adaptation of a U.S. Army Command and General Staff College (USACGSC) course (P313, Forward Deployed Force Operations - European Setting) to provide the strategic and tactical environment. All

members of the group will be given time to familiarize themselves with the scenario and situation map. We will be asking each of you to role-play a specific Division TOC personality, such as Commander, G-2, G-3, etc.. All of you are probably familiar with the role-playing technique from your days at USACGSC.

For the purpose of this exercise we will ask each of you to make an unrealistic but necessary assumption, namely that collection sources have advanced to the point that they may provide you with any information you need, concerning enemy forces, friendly forces or the terrain. Also, we recognize the fact that a major problem in the TOC environment is not so much obtaining information but storing the information once it has been obtained. For the purpose of this exercise, we must ask you to ignore the problem of information storage. Once again, this may seem very unrealistic, but it is important to this research effort and we ask for your cooperation in this matter.

Since our objective is to translate doctrine into guidelines for graphic portrayal, we will ask that you relate your information needs to the fundamentals of doctrine as specified by FM 100-5 and FM 71-100. For example, the first and second fundamentals of defense are "Understand the Enemy" and "See the Battlefield;" and we ask you to reflect on what information you would need in order to "Understand the Enemy" and "See the Battlefield." Please note that we are not asking you what you do to understand the enemy and see the battlefield; we are not looking for a job description, rather, we are trying to identify the information requirements necessary for accomplishing the job.

APPENDIX A-2  
ELICITATION SCENARIO

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## STRATEGIC SCENARIO

### Strategic Environment

The reality of deployed NATO and Warsaw Pact forces in Northern and Central Europe inexorably poses the threat of tension and crisis escalating to war. Both the United States and the Soviet Union have vital national security interests in Europe that are dramatically reflected in their military contributions in the two opposing alliances. Combined with military forces of other alliance/pact members, the European theater is composed of large, modern and potentially destructive forces unparalleled in the history of warfare.

NORTHERN AND CENTRAL EUROPE	NATO	WARSAW PACT
Combat and direct support troops available	625,000	895,000
Tanks	7,000	19,000
Tactical aircraft	2,050	4,025
Nuclear weapons	7,000	3,500

### Strategic Developments

It is now 6 August 1980. Amid a background of steadily deteriorating relations between NATO and the Communist powers and increasing global tension, ministers of the Warsaw Pact nations meet with the Politburo and agree to attack West Germany. East Germany, Poland and Czechoslovakia are most receptive and their forces are called on to participate in the offensive. Hungary, Bulgaria and Romania will move forces to the border of the southern NATO countries to prevent NATO from reinforcing central Europe. Covert preparations are initiated, to include the assembly of rolling stock and increasing units to full strength.

Subsequent chronological events leading to hostilities are:

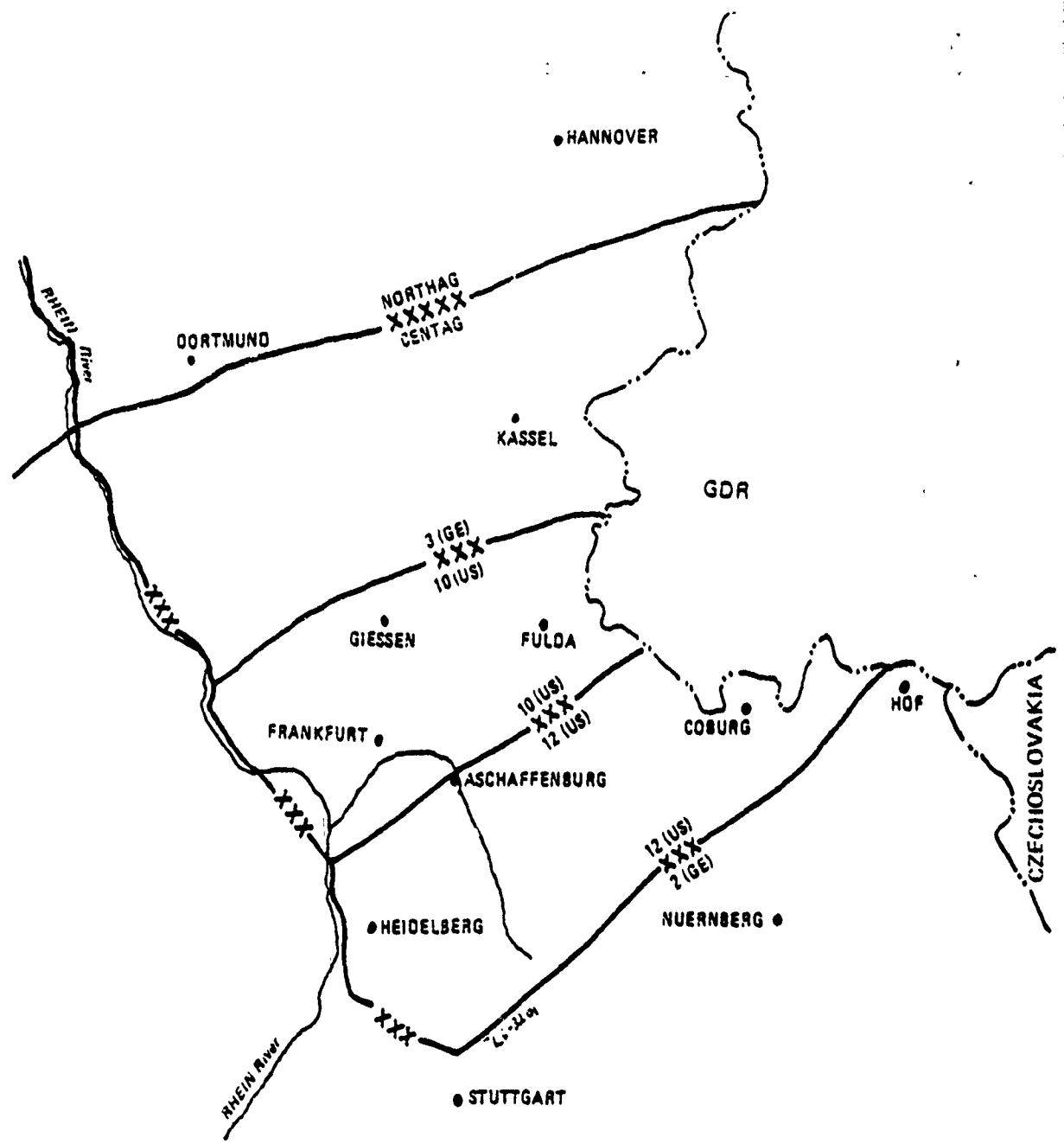
- (1) On 8 August, Warsaw Pact nations initiate full mobilization. Pact nations make every effort to limit NATO intelligence operations and thus hope to complete substantial military preparations without permitting a firm indication of their intent.
- (2) On 9 August, Moscow publicly announces a forthcoming field exercise to test Warsaw Pact defense plans and at the same time a restriction on foreign travel within Warsaw Pact countries is invoked.
- (3) On 10 August, intelligence reports indicate that Soviet military traffic from western USSR to Poland and East Germany is unusually heavy and appears excessive to the needs of the previously announced field exercise. Supreme Allied Commander Europe (SACEUR) orders a state of Military Vigilance.
- (4) By 11 August, the Warsaw Pact buildup in Communist Europe is apparent to the West. Increased rail, road and air activities, as well as the arrival of several Soviet divisions in East Germany have been confirmed. SACEUR requests authority to declare Simple Alert.
  - (a) The request is transmitted to the NATO Secretary General, who chairs the Defense Planning Committee (DPC). This committee consists of the permanent representatives to the NATO council, with the exception of France and Greece and is vested with authority over the major NATO commanders: Supreme Allied Commander Europe (SACEUR)

Supreme Allied Commander Atlantic (SACLANT) and Commander in Chief Channel Forces (CINCHAN). After consulting with their national governments as well as their permanent representatives to the NATO Military Committee, the permanent representatives to the DPC voice no objection to SACEUR's request when polled by the Secretary General, who then authorizes the declaration of Simple Alert.

- (b) As a result, SACEUR alters his allied force headquarters in northern, central and southern Europe. Headquarters, Allied Forces Central Europe (AFCENT), in turn, places its two Army groups and Headquarters, Allied Air Forces Central Europe (AAFCE), along with its two Allied Tactical Air Forces (ATAF's) on increased alert.
- (5) On 13 August, because of the increased pace of the Warsaw Pact buildup, SACEUR issues planning guidance and requests authority to declare Reinforced Alert. The DPC, now in continuous session, approves the request. Efforts by the UN to halt the Warsaw Pact buildup continue to be unsuccessful. Commander in Chief Allied Forces Central Europe (CINCENT) issues theater guidance.
- (6) On 14 August, evidence is received that Warsaw Pact forces are mobilizing and will soon attack. As a result, SACEUR receives authorization from the DPC to declare General Alert. NATO forces begin moving to their assigned emergency defense positions. Obstacle construction is initiated. The U.S. Congress declares a state of national emergency and orders units and members of the Ready Reserve and Standby Reserve

to active duty. The President orders the deployment of dual-based forces to Europe. Other NATO nations commence mobilization at the same time.

- (7) On 15 August, an increase in tactical air movement is detected - generally to bases in the vicinity of known training areas in the German Democratic Republic (GDR).
- (8) On 16 August, Soviet forces continue to deploy into East Germany and Czechoslovakia.
- (9) By 18 August, a major portion of the Soviet theater reserve forces has arrived in western Poland and are deployed along lines of communication that would facilitate their rapid movement into East Germany.
- (10) On 20 August, Pact units are detected moving toward the western borders of East Germany and Czechoslovakia. NATO units patrolling border areas report the evacuation of civilians and other noncombatants.
- (11) On 21 August at 0320, enemy units are detected 1-2 KM from the international border along much of the sector assigned to the 10th (U.S.) Corps (a sketch of CENTAG dispositions is attached). At 0330, heavy artillery and mortar fire is received by several elements of the 10th (U.S.) Corps positioned near the international border. At 0345, a BN size reconnaissance force is seen moving across the border at coordinates NB 6730 (see situation display).



SKETCH OF CENTAG DISPOSITIONS

MISSION

On order, H hour, D day, 23d Armd Division establishes covering force along international border and defends in sector from NB486505 to NB425120, to defeat the first echelon Army forward of Alsfeld.

### Comparison of Forces

#### Friendly Force:

The 23d Armored Division will be operating as part of the 10th Corps in the assigned sector as depicted on the situation display. The division is at full strength, their task organization is given in Table 1. All TOE equipment has been issued, no major equipment shortage exists. Troops have been undergoing intensive combat training. Morale is good.

#### Enemy Force:

The forces opposing the 23d Division are elements of the enemy First Zapadnian Front. The front is composed of a shock army, two combined arms armies, and two tank armies. This front consists of approximately 11 motorized rifle divisions and 12 tank divisions. When the enemy attack, it is estimated that nine of these divisions (3 motorized rifle and 6 tank) will be employed against the 10th Corps. The first echelon will consist of 3 motorized rifle and 2 tank divisions, with 4 tank divisions in the second echelon (see Table 2).

As normal, the front has an additional Army, presently being mobilized, that could be employed in the U.S. sector.

As part of the enemy's strategic reserve, up to 5 airborne divisions could be employed by the central front against the 10th Corps sector.

## TABLE 1 TASK ORGANIZATION: 23d ARMORED DIVISION

### 1ST BRIGADE

1-91 Mech  
1-95 Mech  
1-13 Armor  
1-15 Armor  
TF 2-18 Armor (2T, 1M)  
1-50 FA (DS)  
1/A/440 ADA (atchd for CFA opn)  
1/B/23d CEWI  
(6 GSR Tm, 3 REMS Tm)  
1 IPW Tm/23d CEWI  
1 OPSEC Tm/23d CEWI  
A/23d Engr (+) (DS)  
A/510th Engr Cbt Bn (Corps) (+) (OPCON)

### 2D BRIGADE

1-92 Mech  
1-93 Mech  
1-10 Armor  
1-12 Armor (-)  
1-14 Armor  
1-201 Armid Cav Regt  
1/502d Engr Co  
TF 2-142 Mech (2M, 1T)  
B/1-11 Armor  
1-51 FA (DS)  
2/A/440 ADA (atch for CFA opn)  
2/B/23d CEWI  
(9 GSR Tm, 4 REMS Tm)  
1 IPW Tm/23d CEWI  
1 OPSEC Tm/23d CEWI  
Task Force 510 Engr (DS)  
510th Engr Cbt Bn (Corps) (-)  
B/23d Engr (OPCON)  
D/23d Engr (OPCON)

### 3D BRIGADE

1-94 Mech  
1-11 Armor (-)  
1-22 Cav  
B/1-12 Armor  
1-52 FA (DS)  
3/A/440 ADA (atchd for CFA opn)  
3/B/23d CEWI  
(3 GSR Tm, 3 REMS Tm)  
1 IPW Tm/23d CEWI  
1 OPSEC Tm/23d CEWI  
C/23 Engr (-) (DS)  
C/510 Engr (-) (OPCON)

TABLE 2 FIRST ZAPADNIAN FRONT

CODE NAME ORO  
 CODE NUMBER 351568  
 AREA OF OPERATIONS Central Europe

UNIT	COMMANDER	CODE NO.
CG. . . . .	Marshal DZIEDZIC. . . . .	
CofS. . . . .		
H&S Bn. . . . .		
12th Shock Army . . . . .		339994
2d CAA. . . . .	Gen Col PESTEL. . . . .	200711
8th Gds Tk Army . . . . .	Gen Col MURAVIEV, O . . . . .	439276
5th Gds Tk Army . . . . .		505722
20th CAA. . . . .		
35th SSM Bde. . . . .	Gen Maj BIBIKOV, G. . . . .	528620
31st Engr Const Regt. . . . .	Col KUTUZOV, J. . . . .	
19th Engr Pon Regt. . . . .		
44th Sig Regt . . . . .		
129th Med Regt. . . . .		
Cml Bde . . . . .		
EW Bn . . . . .		
Sig Intap Regt. . . . .		
Intel Regt. . . . .		
2d Arty Div . . . . .		
4th MT Bn . . . . .		
18th Engr Pipelaying Bde. . . . .		

APPENDIX A-3  
DOCTRINAL PROMPTS  
AND  
SAMPLE QUESTIONS

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FUNDAMENTALS OF DEFENSE: SET 1

The following are excerpts from FM 71-100:

1. UNDERSTAND THE ENEMY

Commanders must be thoroughly familiar with the capabilities and limitations of enemy weapons and equipment. They must know how enemy units are organized, how the enemy organizes for combat and deploys, and how the enemy fights--in other words, the echelonment and tactics of enemy units.

...As in offensive operations, the division commander and his staff must also have a sound understanding of where enemy field and air defense artillery, combat service support, and critical command control facilities can be found. These are the systems the division must destroy so battalion task forces, attack helicopter units, and USAF air support can operate successfully against enemy tactical formations.

2. SEE THE BATTLEFIELD

Prior to the battle, the defending commander must organize to defeat different types of likely attacks from several feasible directions. He must then undertake aggressive operations to learn where the enemy is, how he is organized, which way he is moving, and what his strength is. As the battle unfolds he must seek to establish a continuous flow of information, and must deny the enemy similar information about his own forces as he maneuvers to counter the enemy and seek an opportunity to attack.

## SET 1: SAMPLE QUESTIONS AND ANSWERS

### FUNDAMENTAL OF DEFENSE 1: UNDERSTAND THE ENEMY

Concerning the opposing ground threat, you might ask the following questions:

Question: Which type of combat units are we facing?

Possible answer: Armor units.

---

Question: What is the special weapon capability of the units?

Possible answer: FROG.

---

Concerning the reach of enemy threat, you might ask the following questions:

Question: Will terrain limitations alter the range of the weapons platform?

Possible answer: Partially.

---

Question: What is the range of the weapon itself?

Possible answer: Over 2000 meters.

## SET 1: SAMPLE QUESTIONS AND ANSWERS

### FUNDAMENTAL OF DEFENSE 2: SEE THE BATTLEFIELD

Concerning the immediate threat posed by the enemy force, you might ask the following questions;

Question: *What units are moving toward us?*

Possible answer: *Armor units.*

---

Question: *What kind of threat must we respond to?*

Possible answer: *Tactical aircraft.*

---

Concerning battlefield areas of obscuration, you might ask the following questions:

Question: *In which direction is the smoke moving?*

Possible answer: *Northwest.*

---

Question: *How long will the smoke remain?*

Possible answer: *Approximately 20 minutes.*

FUNDAMENTALS OF DEFENSE: SET 2

The following are excerpts from FM 71-100:

3. CONCENTRATE AT THE CRITICAL TIMES AND PLACES

To defend against enemy breakthrough tactics, the commander must not only concentrate forces at the right time and place, but he must also take risks on the flanks....It may be necessary to concentrate up to six or eight maneuver battalions on one-fifth of the division's front to meet breakthrough forces which may number 20 to 25 battalions.

Remaining ground is then covered with air and ground cavalry, remaining battalions, and attack helicopter units.

Concentration of field artillery is equally important. Field artillery fire can often be concentrated without moving batteries. In extended areas, however, field artillery batteries must be moved to positions within range of the main battle.

Air defense batteries and platoons pose a special problem. The first priority for deployment of division air defense batteries in the defense should be protection of the division command control facilities and operations in the division support area. Some Vulcans may be used to protect forward brigades.

...Close air support must be applied in mass, in time, and at the critical point, supported by a well planned and conducted air defense suppression operation.

---

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## SET 2: SAMPLE QUESTIONS AND ANSWERS

### FUNDAMENTAL OF DEFENSE 3: CONCENTRATE AT THE CRITICAL TIMES AND PLACES

Concerning the point of enemy penetration, you might ask the following questions:

Question: *What is the orientation of mass of enemy units reported moving across the FEBA?*

Possible answer: *Heading towards center of sector.*

---

Question: *What logical avenues of approach are available in that direction?*

Possible answer: *Avenue of approach B.*

---

Concerning the identification of priority targets, you might ask the following question:

Question: *What are the enemy's tactical nerve centers (i.e., targets)?*

Possible answer: *Communication centers.*

---

Question: *What is the area of the target?*

Possible answer: *100 M.*

## FUNDAMENTALS OF DEFENSE: SET 3

The following are excerpts from FM 71-100:

### 4. FIGHT AS A COMBINED ARMS TEAM

As friendly units converge on the critical battle site, commanders commit them to combat according to their weapons' capabilities and movement of the enemy force....The first increment of combat power available is usually the massed fire of all field artillery in range....The second increment of combat power available could be attack helicopters....As tank and mechanized battalions begin to arrive, the commander cross-reinforces as necessary and assigns battle positions and missions.

...As the battle develops, the commander must move defending forces from one position to another to take maximum advantage of his weapons, the terrain, and mines or obstacles that he has been able to employ. Combat vehicles must be refueled, rearmed, and repaired as far forward as possible and quickly returned to battle.

### 5. EXPLOIT ADVANTAGES OF THE DEFENDER

The defender's advantages are numerous and permit a numerically inferior force to defeat a much larger attacker. Perhaps the defender's greatest advantage is the opportunity to become intimately familiar with the terrain prior to the battle....The defender can prepare the ground in advance, building obstacles, firing positions, and improving routes between battle

positions....The attacker must adhere to a predetermined course of action and risk being out-maneuvered, or must alter his plans as the battle develops and suffer from uncoordinated effort....

Each position should combine the best characteristics of a defense and an ambush. Several positions designed for mutual support should be used to multiply the strength and value of each. The combination of all these advantages repeated in each set of positions in depth, supported by field artillery, offensive air support, and attack helicopters, should enable the defender to inflict very high losses on an attacking enemy.

### SET 3: SAMPLE QUESTIONS AND ANSWERS

#### FUNDAMENTAL OF DEFENSE 4: FIGHT AS A COMBINED ARMS TEAM

Concerning the TAC air situation, you might ask the following questions:

Question: *What type of air support is available?*

Possible answer: *Close air support.*

---

Question: *What type of attack capability?*

Possible answer: *Anti-tank.*

---

Concerning the relative defensive readiness of friendly units, you might ask the following questions:

Question: *What degree of combined arms status have they achieved?*

Possible answer: *Tank/infantry/artillery team within air defense umbrella.*

---

Question: *What is the fire relationship among units?*

Possible answer: *Overlapping fires with supporting positions.*

### SET 3: EXAMPLE QUESTIONS AND ANSWERS

#### FUNDAMENTAL OF DEFENSE 5: EXPLOIT THE ADVANTAGES OF THE DEFENDER

Concerning the obstacles on the battlefield, you might ask the following questions:

Question: *What types of obstacles are available?*

Possible answer: *Mine fields.*

---

Question: *How long can we expect the enemy to be delayed?*

Possible answer: *30 minutes.*

---

Concerning the mutual support of your units, you might ask the following questions:

Question: *What percent of our units have improved their positions and dressed them with fresh camouflage?*

Possible answer: *50%*

---

Question: *What percent of our units have observation posts and patrols out and active?*

Possible answer: *40%*

**APPENDIX B**  
**SEMANTIC FEATURES:**  
**DEFINITIONS/SYNONYMS/RELATED TERMS**

<u>SEMANTIC FEATURE</u>	<u>DEFINITIONS/SYNONYMS/RELATED TERMS</u>
Activity	General category indicating action; engagement.
Air	Air space of the battlefield.
Air Force/Marines/Navy	Service branches other than Army.
Amount/Quantity	Number of something; "how many".
Artillery	Cannon or missile launchers.
Attack/Counterattack/Penetration	A combat action characterized by fire and maneuver, culminating in a violent assault. Penetration is a form of offensive maneuver that seeks to breakthrough the enemy's defensive operations, widen the gap created and destroy the continuity of his positions.
Availability	Readiness based on current activity and under communications control (in contact).
Behind FEBAs	General category indicating that area of interest which lies behind the FEBAs, this includes the participants area of responsibility as well as the area on the flanks.
Capability	Potential of unit based on TOE, training, tactics, personalities, etc.
Configuration	The arrangement of units; template; pattern.
Corps	The echelon higher than participant echelon.
Control Measures	Boundaries, coordinating points, contact points, etc., which assign responsibilities, coordinate fires and maneuver and generally manage combat operations.
Decontamination	Special purpose area for ridding personnel and/or equipment of contaminants.

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<u>SEMANTIC FEATURE</u>	<u>DEFINITIONS/SYNONYMS/RELATED TERMS</u>
Disposition/Location	Location of elements of a force, usually the exact location of each unit headquarters and the deployment of the forces subordinate to it; grid coordinates; "where."
Division	Echelon of survey participants.
Drop/Landing Zones	Specified area wherein airborne troops, equipment and supplies are dropped by parachute or free fall delivery of supplies and equipment or area used for the landing of aircraft.
Enemy	Opposing force; Soviets.
Engineer	Combat engineers including bridging, minefield emplacement and clearing, position fortification.
EW/Communication	Includes electronic warfare measures, electronic countermeasures, electronic counter-counter measures as well as the communication nets between units and headquarters.
Flanks	Area's adjacent to the participants area of responsibility.
Forward FEBA	General category indicating that area of interest which lies in front of the FEBA; enemy area; enemy terrain.
Friendly	Own; my; our.
Ground/Field	Ground space of the battlefield.
Indication	A sign or signs which point to possible intentions or likely actions.
Logistics	Supply (all classes), maintenance.
Movement	Relocating of troops, equipment, enemy.

<u>SEMANTIC FEATURE</u>	<u>DEFINITIONS/SYNONYMS/RELATED TERMS</u>
Objectives/Plans	The physical object of the action taken. Method by which objective or operation will be accomplished.
Obstacles	Any natural or artificial obstruction that canalizes, delays, restricts or diverts movement of a force; barriers.
Own Sector	Participant area of responsibility.
Personnel	Men; casualties.
Positions	Location or area occupied by a military unit; locations of a weapon, unit or individual from which fire is delivered upon a target.
Procedure	OP; chain of command; method or methods.
Projected	Predicted; future.
Range/Distance	The distance between any given point and an object or target. The extent or distance limiting the operation or action of something. The distance which can be covered over a hard surface by a ground vehicle with its rated payload, using the fuel in its tank and in cans normally carried as part of the ground vehicle equipment. Distance is noted in kilometers.
Refugees/Civil Affairs	Pertains to the civilian population in the area in which military operation is taking place.
Results/Effectiveness	Estimate of outcome of an action; estimate of "how well" an action is going.
Reinforce	The strengthening of a force by committing additional forces, supporting elements or fires.

<u>SEMANTIC FEATURE</u>	<u>DEFINITIONS/SYNONYMS/RELATED TERMS</u>
Reinforcements/Reserves	The portion of the force withheld from action to be available at the appropriate time.
Routes/Avenues	Terrain conducive to the movement of a specified unit, may include terrain relevant to the movement of aircraft.
Smoke	An artificially induced product which attenuates the passage of visible light or other forms of electromagnetic radiation. Includes identification smoke, obscuration smoke and screening smoke.
Special Weapons	Weapons other than those organic to unit; NBC/CBR (nuclear/radiation, biological and chemical).
Status/Situation	Current state of affairs. In the case of units, status refers to effective strength (TOE strength minus losses plus reinforcements). In other cases, status may refer to the degree of readiness or completion, such as status of obstacle emplacement (answer in time to completion).
Supporting Mission	A specific task wherein the action of a force aids, protects, complements or sustains another force in accomplishing its mission.
Surveillance	A systematic observation of airspace or surface areas by visual, aural, electronic, photographic or other means.
Sustainability	Resilience, redundancy, robustness (more than expected capability for extended operations).
Target/Targets	Personnel, materiel or terrain that is designated and numbered for firing.
Terrain	Geographic area.
Time	Estimate in minutes, hours or days; "how soon."

<u>SEMANTIC FEATURE</u>	<u>DEFINITIONS/SYNONYMS/RELATED TERMS</u>
Trafficability	Capability or extent to which the terrain will bear traffic or permit continued movement of a force.
Unit Size	Battalion, Division, Regiment, etc.
Unit Type	Mechanized infantry, tank, armor, etc.
Visibility	The greatest distance toward the horizon that objects can be identified visually.
Vulnerability	Danger status; weakness; problem.
Weapons/Equipment/Platforms	Organic to a specific unit, such as a T-72,
Weather	Atmospheric conditions such as wind speed and direction, temperature and humidity.
Withdrawal/Retrograde/Retirement/Delay	Movement of a command away from the opposing force.
1st Echelon	First wave of an opposing force.
2nd Echelon	Second wave of an opposing force.

APPENDIX C  
PARTICIPANT GENERATED QUESTIONS

CLUSTER 1  
FRIENDLY INFORMATION

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## FRIENDLY AIR/ARTILLERY INFORMATION

What air force support is available - sorties per day? 10 - 15.

How much TAC air will I have to support me? 20 sorties per day.

Can we get additional immediate airstrikes (CAS)? From ALO from USAF.

What TAC air other than our organic CAB do we have available now to strike at the enemy's breakthrough point? None (number of sorties and time on station).

What helicopter airlift capability is available to move forces on the battlefield? List of units available and lift capability expressed in terms of units (i.e., 3 rifle companies in 1 hour).

What close air support is available to block his penetration and what response times can we expect? List of sorties by type, type ordnance expected to be delivered and response times.

What is the status of friendly and enemy close air support? Type A/C available and times available on station if called, i.e., H + 30 min.

How many attack helicopter sorties can I generate each day? 75.

Are attack helicopters available? Yes, 2 sections.

What is the availability of attack helicopters? 2 teams.

What anti-tank helicopter capability do we have? 30 cobras.

Are armed helicopters being used independently? If not in Bde Co control separate zone of operations designated or fire control measures (FCL, FCA) used.

How many sorties of TAC air are available and what armament do they have? 20 sorties, cannons, rocket, antitank.

What chemical warfare capability do we currently have? TAC air can deliver x sorties of x chemical bombs.

What is the tactical air/Army air capability? Reaction time? Ordnance?

How many sorties of CAS are preplanned? According to OPORD.

Does the Div have it's attack helicopters in G.S. or D.S. of Bde?  
Initially in G.S. under Div troops with priority to 2d Bde, 3 Bde and  
1st Bde.

What procedures used to coordinate CAS in BDE/DIV sector? Air corridor  
to a CFZ wide enough to allow attack and breakoff.

How much air cover do I have and how effective is it? We have air super-  
iority.

What friendly fires can be massed on enemy penetration? Artillery, TAC  
air.

What combined fires can be placed on enemy penetration? Arty, helicopter,  
TAC air.

What friendly fires can be placed on enemy reinforcements and avenues of  
approach? TAC air, artillery.

What forces are engaged in main attack - friendly and enemy? Fr - 2 TF  
of 2nd Bde; enemy - 2 armor Bns, 3 mech Bns, arty, TAC air.

How well are our means of fire support being coordinated? Subjective  
answer.

What are the results of our fire support use? Units destroyed.

What are the control measures for controlling indirect and air support  
during friendly movement and in congested common battle areas? Designa-  
tion of one command and control HQ.

Will the priorities of fire support be altered due to the situation? Yes,  
as determined by designated headquarters - Div or 1st Bde, etc.

How much general support field artillery and/or artillery from Corps and  
Army can we have in the Division sector? What is their ASR? 2 8" Bns  
8 rounds per tube per day.

What is the ASR (available supply rates) for field artillery ammunition?  
20 rounds per tube per day.

What is the status of our air defense forces? Locations, strengths, and  
ammunition availability.

What is FA location? 3 DS locations, 1 GS locations, all ranging FA that  
can affect our sector.

What is the status of FA tubes, i.e., how many are operational? From readiness report.

What percent of his TAC air and FA ammunition resources will he use in the attack? 50% save, 50% for exploitation.

What percent of the TAC air and field artillery ammunition will we allocate to various phases of combat? Save a minimum of 30% of resources for a counterattack.

What fires are available to concentrate on different parts of the obstacles? DS artillery, GS artillery, tanks, TOWs, DRAGONS, small arms.

Have preplanned FA delivered minefields been employed? Helicopter delivered? From Bn FSO.

## FRIENDLY LOGISTICS AND OTHER UNIT INFORMATION

What is my ASR for all types of ammunition? 155mm - , 8mm - , ADA -

What is the CSR and is additional ammunition available? According to the OPORD request through Div to Corps to group.

What kind and how much back up support can I expect for class IX? As needed.

What is the current friendly ASR (available supply requirements)? (Do we have enough ammunition with forward elements?) Yes, units are making every shot count.

How and how much of my needed class V, III and I be delivered? By rail to the Div support area, \_\_\_\_\_ gallons/day diesel.

What is the supply - resupply levels by class or item? Class III, V or M60A1, M109.

What is ammunition status by type? From BN S-3.

What is the status of forces of the reserve elements? Strength, logistical profile, ammunition status.

What is the status of combat power of my units? Per TF - number of weapons systems, status of class V and III and positions status.

Are there any restrictions on ammunition supply rate? 4.2" and 81mm are in short supply - 80 rounds per day per tube, all others unlimited.

What is the status of resupply to the Div of class III, V and VII? Gallons per day of class III, number of rounds of class I and number of tanks, etc.

Will my supply procedure be manual or ADP? ADP.

What is the policy on exchanging deadlined combat vehicles with existing theatre stocks? As required.

What is the current status of friendly forces in terms of major end-item availability/service-ability? List of losses/projection of resupply to units.

How much of our arty can range main attack? 2 DS and 1 GS Bns.

Are special weapons available and in range of the main attack? 155mm - 3, 8" - 2, both - chemical.

What is the distance between Division support area and front line units?  
20KM.

What is FA organization combat/tactical missions? 3 DS BNS, 1 GS BNS,  
\_\_\_\_\_ attached reinforcements.

What is the friendly FA order of battle? A Corps group (by type Bn) is supporting the Division and tactical missions assigned to it and organic units.

What additional artillery do we have in support of the Div (non-organic)?  
1 Bn 175 G.S., 1 Bn 8" G.S.R.

What type and how much of a logistical support base do we have to back up the Div? A COSCOM package with the following - maintenance Bn (DS and GS), 2 heavy truck companies, medium and heavy helicopter Bn, etc.

What engineer support is available to dig in and construct fortifications?  
1 engr Bn (combat).

What is the mix of combat forces now committed in each area? 2 arm, 1 inf 1st Bde.

Do the Bdes have a good mix of tank/mech infantry units in their TF's in relation to the terrain? Yes.

How long to fortify 1 mech Bn, reinforced with 1 tank co.? \_\_\_\_\_ hour.

What is the task organization? Composition, unit designations.

Where are the fields of fire? Tanks, TOW, DRAGON, small arms.

What are the terrain uses for the covering force?

## FRIENDLY LOCATION INFORMATION

Where should ammunition and POL be stockpiled?

If I reinforce out of sector, where are class III and V pre stock points? Class III PV 116113, Class V PV 111111.

What is the current location of ammunition supply points? Locations by coordinates?

Where are my best defensive positions? Along west bank of \_\_\_\_\_ river.

Where are the CPs locations? Six digit grid coordinates.

Where are the areas that can be used to decontaminate vehicles and equipment? Fire pond located PV 116117.

Where are targets I can engage? Unit locations, etc.

What are the locations of other friendly echelons of units? Combat units located at \_\_\_\_\_, log maintenance \_\_\_\_\_.

Where are the friendly units to company level? Six digit grids.

What is the status and location of fists, should they be re-allocated? From FSO.

What is the current disposition of security forces (cav/air cav) forward of the defending brigades? 2 sir/cav troops screening.

Where are the prepared positions in my flank sectors (assuming I reinforce into these sectors)? Company position PV 116136.

What types of surveillance means are available and where are they? Locations of observers, radar - counter artillery, personnel, RECCE, photo electronic.

What is the special weapon allocation for the 23rd Div and where are the units capable for firing them located? List of weapons and locations.

Where is the brigade and division CFL plotted? Shown as line approximately 1000 m front of defending BDE.

If I reinforce outside sector where are the coordination points? Coordination point PV 116111.

Where is the FSCL plotted? In Corps zone forward of division area plotted on map.

What is the status of forces on my flanks? Full strength, active defense, coordinating point at \_\_\_\_\_.

What are the fire control measures? FSCL, FCL, CFL.

Are no fire areas, free fire areas applicable - how plotted. No fire area independent operation - or sensitive area (important bridge) free area for no friendly troops - USAF bomb drop.

Where are the friendly barriers? Mine field at PV 116131.

Where are my obstacles placed? Locations.

Where are the obstacles? Grid coordinates - trace.

What is the status of obstacle/barriers? Where, activation, execution status.

What is the status of the barrier plan execution? List of barriers constructed/executed with locations.

What are the details of the obstacle plan? Minefields, tank ditches, wire, natural obstacles, defensive fires integrated.

How effective is my barrier plan? Enemy is avoiding mines, etc.

What is the status of Corps engineer units to assist in barrier construction? 1 cbt eng Bn available in 12 hours.

What friendly units are being jammed most?

Do I have rear area problems? Yes, one platoon penetrated, etc.

Where are Corps arty assets in the division area and those in other areas that can support the division?

What is the status of elements in 10th Corps that could be used to reinforce the 23rd Div.? List by type and location.

Where are the Corps and Division reserve located? Coordinates.

What Corps units are available for use in the Div. sector and what are their reinforcement times? List of units and times.

What Corps assets may I ask for?

How long will it take Bde in north to reinforce southern element, barring no major terrain obstacles? 1 hour.

Can Corps provide reinforcements if necessary - where are they currently located? Yes, 1 div (-) in reserve, 1½ hour march time away.

What friendly forces can be shifted to contain penetration if needed? 1 bde (-) in the north.

Can we counterattack in south to contain penetration? No, Bde in north does not have capability.

What additional tank obstacles can be emplaced by combat engineers on major avenues of approach in the south to slow enemy advance? Can knock down trees blocking all routes through forested area x.

Can our units dig new defensive positions, prepare obstacles on major enemy avenues of approach to rear of current defensive lines - what engineer support available? Div Engr Bn (-) can put priority on effect in x area.

**CLUSTER 2**  
**ENEMY INFORMATION**

## ENEMY AREA/ACTIVITY/UNITS

What Soviet forces are deployed in the South? 15 bns; 6 tank, 9 inf.

What is the disposition of the enemy forces in the main attack? 4 MRR moving NE at PV 116135, 2 Tk Regts moving NE at PV 117144, 1 Gav Sqd moving NE at PV 119143.

What is the strength of enemy supporting attacks? MR Bn moving NE at PV 116113 is at 50% strength, it is supported by 2 tank platoons.

What is the configuration of the 5 divisions in the enemy first echelon? 1 MRD and 1 Tk Div in the north, 1 MRD and 1 Tk Div in the center, 1 MRD in the south.

The 23rd Division is opposed by 9 divisions, at what percent are those 9 divisions? The 3 MRD are at 100% strength, the 6 Tk Divs are at 85% strength.

What type and how many special weapons does the enemy have? 3 Bns for FROG III (18 launchers/Bn, 30 warheads/Bn with yields from 1KT to 10KT).

Will the enemy use chemical or biological warfare first? Chemical yes biological - no, chemical posture, unit type, equipment and locations.

With what type and size of units will the enemy move into our sector?

What type of forces oppose my unit in my sector? Tank Bn located at PC116151.

What size and type of enemy units are we facing? Armor/mech infantry division.

What is the quantity and type of air against us? What targets will he hit? Standard air of the Soviets; Bn size troop concentrations and Bn or higher size HQs.

What type of forces oppose the units to the flanks of my units? MRR located at PC 115121.

What type and how many reserve units does the enemy have? 2 tank divisions within 12 hours.

What are the enemy's rates of advance? Number of minutes by enemy unit.

What are the indicators of the 2nd echelon commitment? Presence of tank regiment/tank army.

Where is the tank army of the Soviet front and what is it doing? Location and moving, or stopped.

What are the actions of enemy 2nd echelon forces - i.e., are they oriented to a specific area to exploit penetration? Locations and composition.

What are the locations of enemy EW, CC, FS, CSS? Grid coordinates.

What is the location of enemy command and control HQs? Grid coordinates.

Where are the bulk of enemy tank forces and what direction are they moving?

Where is the enemy force in my sector? Armor unit located at PC186115.

Where is the enemy in my flank sector? Armor unit located at PC116151.

What are the locations and types of artillery units? Locations known as of xxx hours are \_\_\_\_\_ types are \_\_\_\_\_.

Where is the enemy artillery? 155mm Howitzer Bn located at CP191111.

Can I locate enemy artillery units? Engineer units? Logistics units? yet - attack them, no - find them.

What are the latest enemy locations and enemy configurations of units?

What is the disposition of enemy forces in the 1st echelon? Whatever arrangement of armor, arty and motorized forces are there.

What is the configuration of enemy units within penetration area? Mech heavy, armor heavy.

What type of enemy equipment is in the units? T-72 tanks - latest personnel carriers.

What type of cannon artillery are supporting the opposing force? 120 mm direct support artillery, 152 mm general support artillery and 130 mm guns not from the opposing division but attached from higher artillery HQ.

What is the current range fan for all friendly and enemy artillery, i.e., what friendly units are in range of enemy artillery and vice versa? List of units by type, i.e., 130 mm, 122 mm, etc. with current locations.

How many tubes of what kind of artillery can be brought to bear in my sector by the enemy? What sustained rate of fire? 300 tubes capable of 300 rounds per minute.

What is the state of readiness of the enemy force? 3rd MRR has been fighting for 6 days, has sustained 50% losses equipment, 30% loss of personnel, officer strength at 20%, morale is low.

Where are the drop zones and landing zones in our area (i.e., behind the FEBA)? Field to the west of the battalion sector will support regimental size airborne drops or 30 helicopters.

Where are the potential drop zones in the area for enemy airborne operations? Vicinity \_\_, etc. with size and troop capability.

Where are the avenues of approach in my sector? What density of armored vehicles will these avenues of approach support? The Fulda River Valley running NE to SW is a major avenue of approach capable of supporting one MRR.

What is the enemy capability to sustain operations, location and distance from MSR? 2-3 days of operations, MSR vicinity \_\_, with support units located \_\_, with probable displacement to \_\_.

What areas are contaminated by enemy chemicals? Geographic locations.

Have enemy chemicals/nukes been used, and where?

What are the enemy units doing? Presently in assembly areas located at the following coordinates \_\_\_\_\_.

Where are the enemy offensive chemical warfare units? Near multiple rocket launchers.

Where are enemy nuclear units? Probably in 2nd echelon of front.

Where is the enemy smoke being most employed?

From what enemy locations are most electronic emissions radiating?

Does the enemy have counter-artillery radar? Has it been turned on? What is his frequency and location? Yes, no, unknown, unknown.

Where are the enemy EW units? With the 1st echelon.

Where is the enemy? (to Bn level) six digit grid coordinates.

Where are the larger (Bn size and up) enemy targets located? Grid coordinates.

Where are enemy air strikes concentrating?

What is the enemy capability to conduct air mobile operations? Where? Enemy can secure critical road junction on my route of lateral communications at PV 116111 with one rifle company.

Where is the enemy FA concentrating? Where is the enemy general support field artillery units located, especially FA located near roads? Center sector, mass of FA near good roads and trails.

What is the location of enemy field artillery? Closer to the front lines than usual.

What are the future likely enemy ground objectives (i.e., terrain, cities, communication centers)? Continue west to high ground vicinity xxx.

What is the enemy disposition on our flanks and possible operations to Corps rear areas?

Where is the major Soviet axis of attack? In the south.

Where is the enemy most likely to conduct a breakthrough operation? In the center sector (brigade).

Where is the main attack? Along axis \_\_\_\_\_ to \_\_\_\_\_ to \_\_\_\_\_.

What is the density of enemy units in the area most likely to be the area for penetration? Location by coordinates.

What is the enemy nuclear weapons capability? Does he plan to use it first? FROG, standard weapons; yet (location).

What is the enemy capability for biological and/or chemical warfare? Chemical - deadly gases available, biological - yes.

Is the enemy susceptible to propaganda shells, particularly the non-Soviet troops? No, the attack forces are highly motivated and well trained.

At what point is the enemy most vulnerable? Vicinity \_\_\_\_\_ due to restriction of narrow front.

What is the enemy capability/strength disposition? % levels, locations.

What are the current enemy weaknesses? Supply, communications.

## ENEMY WEAPONS AND EQUIPMENT

What is the current fighting capability of enemy units within the penetration? 50% strength in personnel and equipment, low morale.

What are the enemy losses? What is his combat capability? The MRR in the northern sector is at 50% strength and has lost all tanks.

What is the enemy strength? % level at Bn in personnel and equipment.

What is the approximate percentage fill of the enemy weapons and personnel of the units? 90% combat fill (85% weapons, 95% personnel).

What losses have we taken, as opposed to the enemy? 10%, enemy 15%.

What is the enemy bridging capability? The enemy has 14 mobile bridges.

What is the trafficability of the area - friendly, enemy, heavy vehicles, light, etc.? By sector high speed, reduced speed and impassable.

What are the specifics on the major equipment of the opposing forces? Armor T-72, T-60, T-54; strength, etc.

What is the current combat power strength of friendly units? % levels of weapons, crews, mobility.

Does intelligence report any large amount of artillery ammunition being moved forward? The total amount of artillery projectiles reported in the area opposite our forces is greater than the unit's capability to carry - indicating preparation for attack.

What is the quantity and type of conventional field artillery ammunition? More than or less than Soviet basic load.

Where is the enemy stockpiling POL?

What is the enemy air defence capability? Organic Redeye.

What type of enemy FA is there? Standard Soviet organization, 120mm, 152mm, etc.

Have any trends been established by the enemy in the use of his fire support? Command and control field artillery, etc.

What are the effects of enemy artillery on my forces? Do I need to move units? Can I sit out an artillery attack?

CLUSTER 3  
TIME/CAPABILITY INFORMATION

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What are the critical time/distance factors for friendly units? TF 1-16, 2 hours to position 10, etc. (2-10 arty displace to cover position 10 1½ hours).

What are my day and night time-distance factors for movement (forward, back and laterally) Show times by T+.

When will the enemy close on FEBA? Time, distance, attrition.

What is the reinforcing distances/times for the covering forces locations?

What is the time/distance for units in the 1st and 3rd Bde sectors plus the reserve to move to reinforce the Div in the enemy breakthrough sector? 1st Bde - TF etc., 3rd Bde TF etc., Res. TF etc.

When will the battle positions be occupied? Time.

Can field artillery batteries move easily and quickly to forward, rearward, alternate and supplemental positions? East to west or west to east good movement, north to south fair (or answer with a time range).

What alternate/subsequent battle positions are available, are they prepared - when will they be prepared? For each Bn and artillery Btry, no, 3 days.

Which obstacles are in (will be in) at the time of attack? 24 hours - mine fields, 48 hours - complete obstacle plan, 60 hours - plus bunkers and dug in weapons.

For how long can the enemy sustain combat operations on a continuous basis in my sector? For 72 hours.

What rate of advance are the enemy forces capable of maintaining - or - based on the resistance we can offer when will the first echelon reach our main defensive positions? Approximate time.

When will the 1st echelon attack? Measured in time (hours and minutes) or a "gate" of time.

What is the "distance" between the 1st and 2nd echelons? Measured in time.

What is the enemy capability to reinforce in the battle area? 3 divisions within 4 hours.

What is the enemy capability to reinforce in my sector? Can reinforce with one MRR in 3 hours.

What is the enemy capability to employ anti-tank helicopters? 15 companies at an employment rate of once each 3 hours.

What is my capability to reinforce with TOW Cobra helicopters? 2 companies each 3 hours.

What is my capability to reinforce with high performance aircraft? One sorti per day for the first seven days.

What is my capability to reinforce with artillery? 10 tubes of 155 mm Howitzer at 15 rounds per minute.

What is the enemy capability to employ high performance aircraft? 17 sorties of MIG 21 in my sector per day.

What forces are altering planned movement speeds and capabilities? Route 17 is impassable due to civilian traffic accidents, etc.

What is the enemy current rate of movement and capability to increase? 10-15 Km/hr on particular axis increase to 20-25.

**CLUSTER 4**  
**STATUS INFORMATION**

What is the communication capability and status? Net status (who can talk).

Can I (Commander) communicate with subordinate tactical commanders? Can DTOC talk to Bde TOC?

Are my tactical communication links working and secure? Yes.

Does the enemy have secure lines of communication? Yes, secured with troops and air defense weapons.

What is the status of prepared blocking or secondary positions? 60% complete.

What is the status of the friendly battle position occupation and preparation? Degree of preparation or occupation.

What is the status of routes between successive or alternate battle positions? Conditions of roads, bridges.

What targets are we developing by each means of target acquisition? SOTAS. SLAR.

What is the situation on the Divisions northern and southern flanks? Trace - enemy and friendly.

What's the situation with Division on my flanks? Holding.

What is the status of the defending/delaying forces in the bridges actually executing the covering force mission? Locations.

What is the situation regarding roads and trafficability? Roads clogged, bridges out, etc.

What is the status of road network into my area? Map with roads, bridges, etc.

What is the current weather and predicted effects? Temperature and wind direction.

What is the immediate and long term weather?

What are the weather and light conditions? Standard briefing (including visibility information).

Is the weather favorable for the use of smoke? Yes, 3-5 knots from north to south.

What is the weather outlook with respect to trafficability and visibility for friendly and enemy forces in the air and on the ground?

What are the visibility conditions? Impact on air support, ground visibility limitations of 300 meters.

What is the terrain condition in the area of operation? Trafficability estimate.

CLUSTER 5  
ACTIVITIES/PROCEDURES INFORMATION

Are there any signs/indications of NBC offensive employment? Units do not appear to be using NBC protective procedures.

What are the indications of enemy activity? They are in attack formations and could attack in 12 - 24 hours.

Are the enemy forces consolidating their positions? They are digging in and placing obstacles (i.e., mines, etc.).

Where is area of most significant forward enemy movement?

What is the combat ratio of friendly to enemy systems - battle calculus - do I win or lose? Win - , lose - get help.

How many of my units are engaged? 2/3.

What hapening in other Corps sectors? Enemy is attacking in large scale operations.

Are friendly committments sufficient to permit concentration by companies/ teams and BNS/TFs rather than brigades?

Has CBR been used? No, has not employed.

Have any special weapons been employed, if so, what kind and where? Number of weapons, by types, etc.

Can I employ special weapons? Yes or no.

What is the time required to get friendly release of special weapons? 40 hours.

Will friendly TAC NUC weapons be employed? How many? Affect on FA support? The number used will degrade conventional artillery support.

What is the number, location, load status, release and authorization of nuclear weapons for the friendly forces?

Has smoke been authorized for use? Available? Used? From BN FSO.

Are any FCL used? To substitute for boundary to coord fire support when no boundary applicable.

What is the refugee - civil affairs situation? Numbers and locations.

What is the civilian occupation of critical built-up areas - size, activity? HANN vicinity \_\_\_, 50% preparing to evacuate.

CLUSTER 6  
TERRAIN/ROUTE INFORMATION

Where are the main avenues of approach - what forces will they support?

\_\_\_\_\_ to \_\_\_\_\_ to \_\_\_\_\_.

What are the avenues of approach? Direction in relation to major terrain features and our key terrain.

What are the useable routes for friendly movement? Route, direction, trace.

What routes are clear for movement?

Where is the enemy main attack (1st and 2nd echelon)? Avenues of approach and locations.

What are the likely routes along which the enemy will commit 2nd echelons? High speed avenues of approach.

What are the likely avenues of enemy withdrawal or reinforcement?

Where are the road networks and high speed approaches both in front and to the rear of the enemy area?

What kind of terrain are they moving through (all forces)? Rolling hills, forested secondary network of roads.

What terrain is available for use of attack helos on enemy armor on likely avenues of approach? Hills, wooded areas, etc.

Does the terrain lend itself to the enemy to reinforce his breakthrough? Yes, both from the south and the north (reinforcement ability based on the terrain).

What are the natural barriers or obstacles facing the enemy? Mountains, ravines, streams, rivers, bridges.

What are the obstacles to the enemy in my sector? Natural? Manmade? The Fulda River and its associated flood plain is the natural obstacle. The 9 ton bridge over the Fulda River at PC 116171 is the obstacle to the enemy on the avenue of approach from the NW.

What obstacles are critical to movement, MSR, reinforcement, etc.? Bridges, restricted roadways, swamps, etc., without bypass.

What does the terrain look like? Maps, photos, terrain analysis, avenues of approach, obstacles, etc.

CLUSTER 7

PLANS

123

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What is the enemy's main objectives? Some critical terrain feature or major production area.

What is the enemy's tactical doctrine? Frontal attack, penetration, deep objectives.

What are the enemy's intentions? Cross border and march to the sea.

What is the key terrain in my sector? Friendly? Enemy? Hill 116 and Hill 171 are key terrain features for the enemy. The ridge extending from PC 116132 to PC 111191 are the key friendly terrain features.

What terrain is most defensible?

What is the priority of engineer tasks? Bridges, obstacles.

What is the Commander's concept of the Defense? Strong in center, economy force in south, counterattack exposed flanks and to destroy enemy formation, covering force do not become decisively engaged.

What is the impact of communication failures, alternate methods, automatic reactions? Perform as planned and IAW last instructions. Deviate only on receipt of authenticated order.

Any area designated for preplanned TAC NUC? DGZ with minimum safe distance and strike warning time.

What route priorities have we assigned to artillery units in order to facilitate rapid movement and responsive support? Outline of priorities by unit.

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## ENEMY AREA/ACTIVITY/UNITS

What Soviet forces are deployed in the South? 15 bns; 6 tank, 9 inf.

What is the disposition of the enemy forces in the main attack? 4 MRR moving NE at PV 116135, 2 Tk Regts moving NE at Pv 117144, 1 Cav Sqd moving NE at PV 119143.

What is the strength of enemy supporting attacks? MR Bn moving NE at PV 116113 is at 50% strength, it is supported by 2 tank platoons.

What is the configuration of the 5 divisions in the enemy first echelon? 1 MRD and 1 Tk Div in the north, 1 MRD and 1 Tk Div in the center, 1 MRD in the south.

The 23rd Division is opposed by 9 divisions, at what percent are those 9 divisions? The 3 MRD are at 100% strength, the 6 Tk Divs are at 85% strength.

What type and how many special weapons does the enemy have? 3 Bns for FROG III (18 launchers/Bn, 30 warheads/Bn with yields from 1KT to 10KT).

Will the enemy use chemical or biological warfare first? Chemical yes biological - no, chemical posture, unit type, equipment and locations.

With what type and size of units will the enemy move into our sector?

What type of forces oppose my unit in my sector? Tank Bn located at PC116151.

What size and type of enemy units are we facing? Armor/mech infantry division.

What is the quantity and type of air against us? What targets will he hit? Standard air of the Soviets; Bn size troop concentrations and Bn or higher size HQs.

What type of forces oppose the units to the flanks of my units? MRR located at PC 115121.

What type and how many reserve units does the enemy have? 2 tank divisions within 12 hours.

What are the enemy's rates of advance? Number of minutes by enemy unit.

What are the indicators of the 2nd echelon commitment? Presence of tank regiment/tank army.